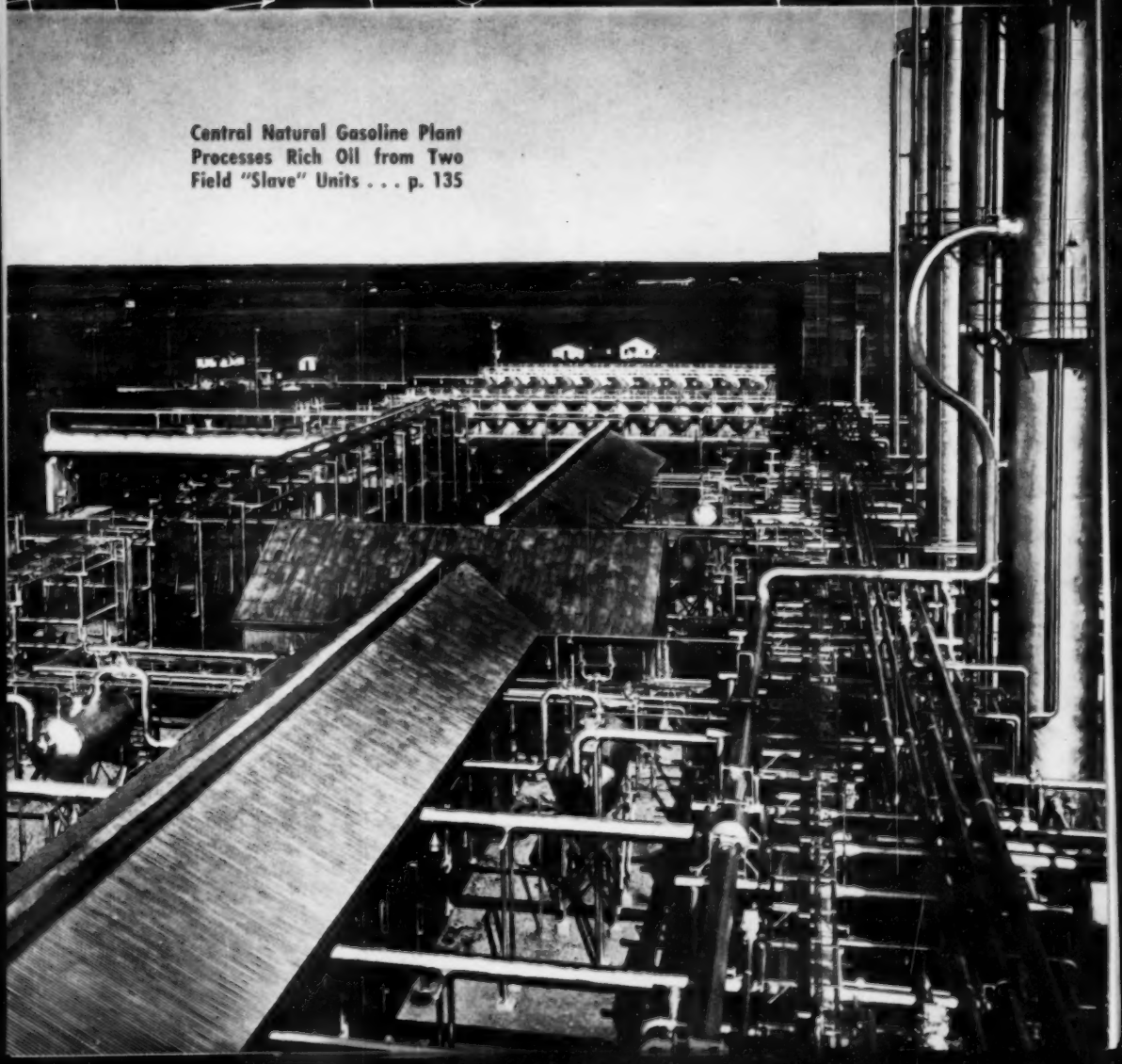
FEBRUARY, 1950
VOL. 5, NO. 2

PETROLEUM PROCESSING

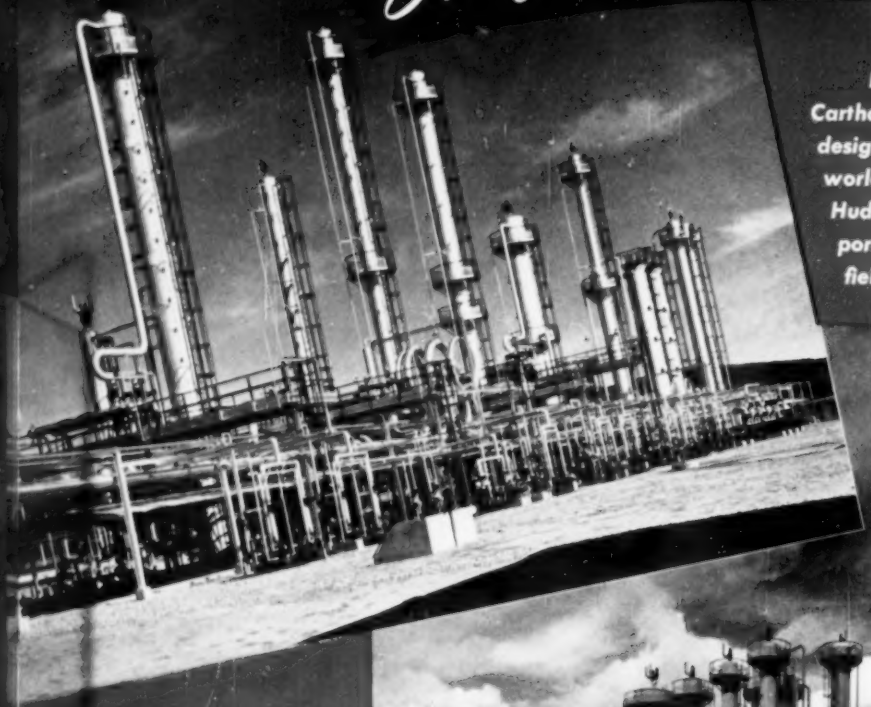
Central Natural Gasoline Plant Processes Rich Oil from Two Field "Slave" Units . . . p. 135



At Home or Abroad

In Boussens, France or Carthage, Texas, HUDSON-designed plants justify the world-wide reputation of Hudson Engineering Corporation as leaders in the field of gas processing.

REGIE AUTONOME DES PETROLES



THE CARTHAGE CORPORATION

Pictured above are two HUDSON-designed plants . . . each processing gas to extract propane and heavier hydrocarbons and water vapor from gas entering cross-country pipe lines. The Carthage Corporation plant, largest of its kind in the United States, is installed at Carthage in East Texas. The French plant, owned and operated by Regie Autonome des Petroles, processes gas from the St. Marcet gas-distillate field, in the foothills of the Pyrennes mountains. This is the largest gas processing plant in Europe.

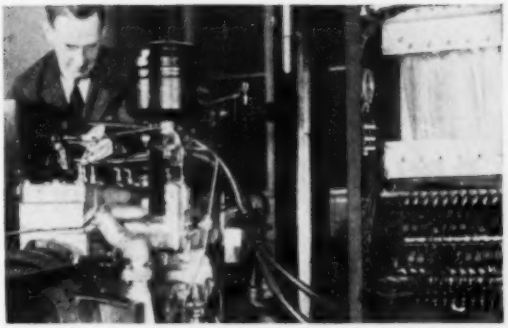
HUDSON

ENGINEERING CORPORATION

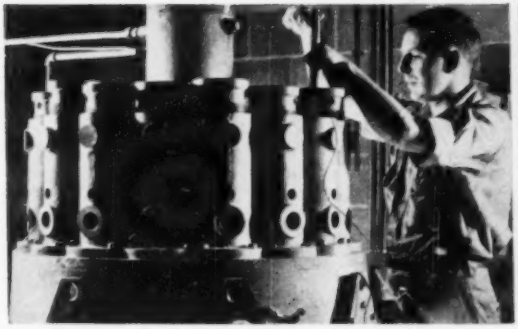
FAIRVIEW STATION HOUSTON, TEXAS

GAS COMPRESSOR STATIONS • CYCLING PLANTS • GAS DEHYDRATION PLANTS • NATURAL GASOLINE PLANTS • FRACTIONATION UNITS • CRUDE TOPPING UNITS • PRESSURE MAINTENANCE PLANTS • HYDROGEN SULPHIDE REMOVAL PLANTS • ATMOSPHERIC AND VACUUM DISTILLATION UNITS

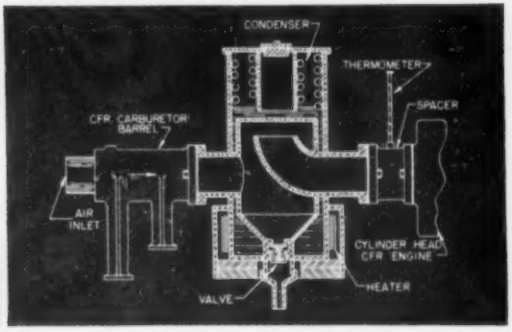
Ethyl-developed research methods useful to refiners



1. Duplicating "road" operation in the laboratory.



2. Testing engine metals under simulated operating conditions.



3. Bled manifold for "knocking" research on single-cylinder engines.

THE DEVELOPMENT of experimental equipment and procedures that will produce reliable data is essential to progress in fuels and engines. For twenty-six years, Ethyl Laboratories have been developing procedures for research on problems relating to engines, fuels, antiknock compounds, and lubricating oils. Many of these have been adopted by other laboratories—some may prove helpful in your research operations.

1. Duplicating "road" operation in the laboratory. The duplication in the laboratory of the performance of engines, petroleum products and antiknock compounds requires a schedule of operation simulating the variations in engine speed and load that are characteristics of road operation. Different types of mechanism—employing pneumatic, electrical and electronic principles—have been devised for reproducing these variations. Illustrated at the right above is one type of automatic control mechanism developed by Ethyl which employs a perforated "piano" roll to operate both dynamometer and engine controls to simulate any desired pattern of road operation.

2. Testing engine metals under simulated operating conditions. The Ethyl Laboratories designed and built for the U. S. Army Air Forces a special furnace (left above). This furnace subjects samples of valve steels to controlled tensile stress under alternate heating and cooling in an atmosphere of combustion products similar to that in engines. This same equipment is used by Ethyl and other laboratories for the testing of alloys intended for fabrication of other engine parts.

3. Multicylinder engine "knocking" research in single-cylinder engines. Some years ago Ethyl engineers measured the variations in the distribution of fuel to the cylinders of engines. It was shown that an irregular pattern of fuel distribution prevailed and that this had a pronounced effect on the knocking tendency of engines and on the relative performance of fuels of different composition. Ethyl engineers have developed a bled manifold for use with single-cylinder knock testing engines that permits, under steady operation, the simulation of transient conditions in respect to fuel distribution existing in multicylinder engines.

* * *

The development of research equipment and procedures is just one part of the overall Ethyl research effort. Ethyl's aim has always been to render a complete antiknock service—to help refiners use "Ethyl" fluid most economically and effectively in the gasolines they produce.

Since 1923—*continuous research to provide better antiknock service*

ETHYL CORPORATION

RESEARCH LABORATORIES

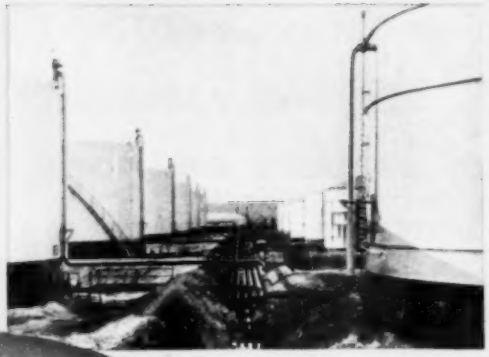
Detroit, Michigan, 1600 West Eight Mile Road • San Bernardino, California, 2600 Cajon Road

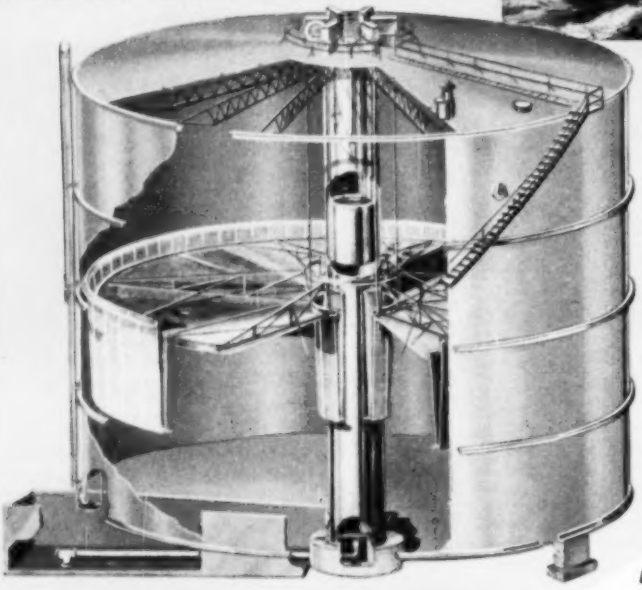
[*To obtain more data on advertised products see page* 192]

Wiggins

DRY SEAL Gasholder

CONVERTS BREATHING AND PUMPING LOSSES INTO PROFITS





LOW INITIAL COST—LOW UPKEEP

100% DRY SEAL
No wet seal corrosion problems—no heating—no fire hazard

VAPOR BALANCING AT STANDARD CONE ROOF PRESSURE

ALL MOVING PARTS UNDER COVER

EASY ACCESS FOR INSPECTION DURING OPERATION

THE DRY SEAL GASHOLDER VAPOR BALANCING SYSTEM

The more it works—the more you save!
One typical gasoline refinery interconnected a 150,000 cubic foot Wiggins DRY SEAL Gasholder with six 25,000 bbl. cone roof tanks. In one week, breathing and pumping losses of 5,220 gallons were saved. In less than 20 months, the whole gasholder installation was paid for (including 5% interest, depreciation, taxes, insurance, maintenance and operating). Ask for a "Pay Out Analysis" of your storage tankage without obligation. And be sure to write for Bulletin VB10, too.

WIGGINS VAPOR SEALS GENERAL AMERICAN

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TRANSPORTATION CORPORATION
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PETROLEUM PROCESSING

Covering petroleum research and the design, management, operation and maintenance of plants processing hydrocarbon materials into fuels, lubricants and chemicals

1213 West Third St., Cleveland 13, Ohio

A Platt Petroleum Publication

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VOL. 5, NO. 2 FEBRUARY, 1950

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A daily independent oil-price reporting service issued from New York, Cleveland, Houston

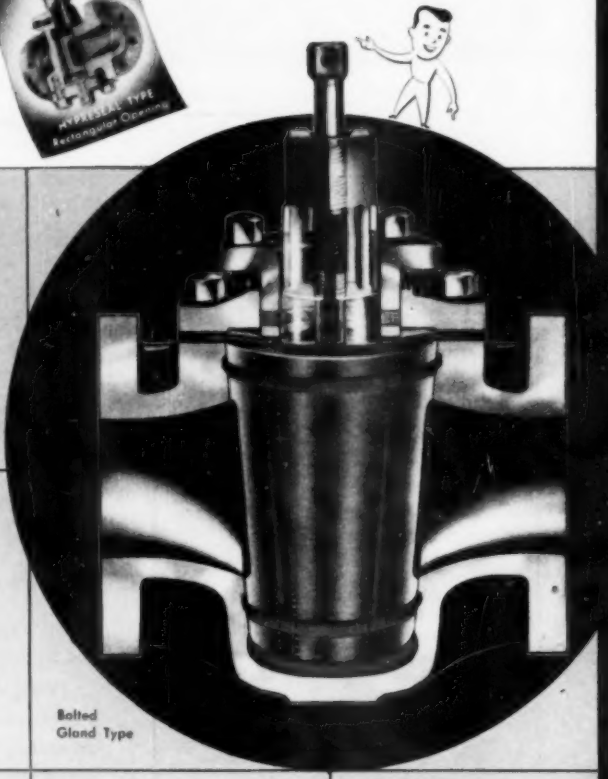
IN NO OTHER VALVE

POSITIVE ROTARY ACTION

Tapered plug, fully lubricated

RESILIENT SHOULDER STEM SEAL

Allows jacking of plug



Bolted Gland Type

SMOOTH PASSAGEWAY

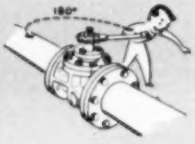
Streamlined, devoid of crevices

CAN BE "CRACKED" WITHOUT LUBRICANT LOSS

Lubricant will not blow out

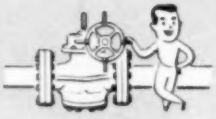
"SEALDPORT" SURROUNDS PORTS

Seals each port against leakage



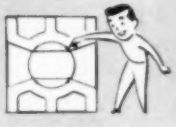
RENEWABLE SEAT WITHOUT REPLACEMENT

Plug can be re-positioned 180°



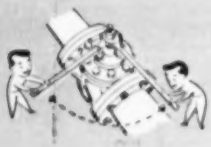
LEAST EFFORT TO OPERATE

Lubricant prevents galling



SEAT OF VALVE NEVER EXPOSED

Line fluid does not contact seat

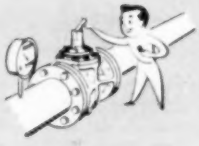


QUARTER-TURN

Simple sliding action

MOST COMPACT SIZES

Can be set in restricted space



RE-LUBRICATED UNDER PRESSURE

Ball check valve holds pressure

ADJUSTABLE UNDER ANY PRESSURE

No need to shut down line

So many features and every one IMPORTANT!

NO BY-PASS NECESSARY

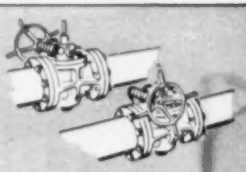
Safe with high differentials

CORROSION AND EROSION EFFECTIVELY RESISTED

Lubricant pressure protects parts

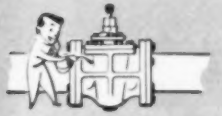
REPAIR PARTS AVERAGE ½ OF 1%

As compared with valve sales



VALVE SETTING IN OPTIONAL DIRECTIONS

Not restricted to one-way flow



A TIGHT SHUT-OFF ALWAYS

Lubricant pressure maintains seal

NO STEM BREAKAGE

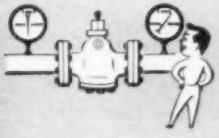
No excessive stress

FULL-FLOATING HYPRESEAL PLUG

Stem is independent of plug

FASTEST CLOSURE IN FRACTION OF USUAL TIME

Can be closed slow or fast



CAN BE OPERATED WITH ANY DIFFERENTIAL

No wedging force to overcome

INTERNAL LUBRICANT PRESSURE CAN BE GAUGED

Gauge can be directly installed

REPACKABLE UNDER ANY PRESSURE

Can be packed in any position

HYPERMATIC AUTOMATIC LUBRICATION SAVES TIME

Self-acting; self-feeding

Nordstrom Valves

NOW AUTOMATICALLY LUBRICATED WITH Hypermatic

Pats. Applied for
Trade Mark

***Nordstrom Valve Division*—ROCKWELL MANUFACTURING CO.**

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...Background for high octane fuels

Today, thanks to the fluid cracking techniques used in modern refining operations, it is possible to produce high octane fuels to match the requirements of engines of high compression ratio. Contributing vitally to this progress has been Cyanamid's development of AEROCAT* Ground and Microspheroidal Synthetic Fluid Cracking Catalysts.

Behind these efficient products, *continually in expanding production to meet increasing requirements*, are Cyanamid's scientifically equipped units, extensive research facilities and the experience and skill of our highly trained technical staffs. *All* of these are at your service to help you select and use the catalyst best suited to your individual needs.

Other Cyanamid specialties for the Petroleum Industry include AEROLUBE* Additives for regular, premium and heavy-duty motor oils . . . AERO** Specialty Catalysts for various chemical processes . . . Gasoline Dyes and Drilling Mud Chemicals. Literature and samples of these products are available on request. Write today.

*[illegible] **Trade mark

AMERICAN Cyanamid COMPANY

PETROLEUM CHEMICALS DEPARTMENT DIV. 83

30 Rockefeller Plaza, New York 20, N. Y.

WHEN PERFORMANCE COUNTS . . . CALL ON CYANAMID

What's Happening!

Important Current News Summarized for Refiners

EXPANSION

Sun Oil Co. has awarded contract to Catalytic Construction Co. for doubling present capacity of catalytic polymerization unit at Toledo, Ohio, refinery. With present 24 reactors expanded to 48, capacity of unit will be 5000 b/d of mixed butane-butylene charge.

Imperial Oil Co., Ltd., will build a 10,000 b/d plant at Winnipeg, with construction to start in early spring and completion scheduled for May, 1951. Crude will be moved either by rail or branch line from a take-off on the Interprovincial pipe line at Gretna, Man. Contract for the $10,000,000 project has not yet been awarded.

Coastal Refineries, Inc., and Mayfair Minerals, Inc., have been authorized by Texas Railroad Commission to build a gas cycling system and natural gasoline plant in the McAllen field, Hidalgo Co., Texas.

Roger Lacey, Inc. has let a $250,000 contract for additions and improvements to the company's 5000 b/d refinery at Big Sandy (Longview), Texas. Plans call for installation of a catalytic desulfurization and reforming unit, additional feed-preparation facilities, and catalytic polymerization.

Socony-Vacuum Oil Co. will build three more TCC units—one each at its refineries in Buffalo, N. Y.; Brooklyn, N. Y., and Beaumont, Texas. These are in addition to four such units which Socony-Vacuum announced last summer for its refineries in Trenton, Mich.; Augusta, Kans., and Beaumont. Completion of all is scheduled for this year. The new TCC units in each instance will replace existing Houdry fixed-bed units.

• • •

PETROCHEMICALS

Pontiac Refining Corp. and Chicago Corp. have decided to go ahead with joint program to build a $15,000,000 oil refining and petrochemical operation in the Corpus Christi area. Companies recently acquired for $756,000 the 100-octane government "avgas" plant operated during the war by Great Southern Corp., which provides a "ready-made" deep water site. Companies' statement said plans and engineering for units to produce annually 60 million lbs. of ethylene glycol, 10 million lbs. of ethylene oxide and 5000 b/d of "high grade" gasoline are substantially complete except for revision to fit the former Great Southern facilities. Other products on which preliminary planning is underway are said to include butadiene, ammonia, ammonium sulfate, ethylene dichloride, butyl alcohol, polyethylene and a "super octane blending agent" of undisclosed nature.

Electric Bond & Share Co. last month disclosed its intention to go into partnership with United Gas Corp. in the chemical and petrochemical field. According to Curtis Calder, chairman of Bond & Share, the two companies have retained the National Research Corp. of Cambridge, Mass., to study the possibilities of going into the field.

• • •

MARKETS, PRICES

Two major trends in prices last month appeared to split the country in half, with January's unusual weather taking the brunt of the blame. Along the eastern seaboard distillates tended lower, whereas throughout the entire midwest fuel oil prices were on the rise.

Warm weather in the east seriously depressed the distillate business. Esso Standard Oil Co., announcing a general reduction in its prices for distillates late in the month, said its 0.2 to 0.6c cuts were brought about by the warmest heating season in 49 years.

Meanwhile, Standard Oil Co. (Indiana) made increases in its fuel oil prices in the midwest, ranging from 0.3c per gal. for light oils to 0.4c for heavy fuel.

In the heavy fuel picture, prices did not show the sharp contrast of light oils between the east and midwest, but the supply developments were vastly different. Chicago marketers and refiners generally throughout the midwest couldn't produce sufficient No. 6 oil to meet demand. Industrial demands in those areas were in high gear. Meanwhile, No. 6 oil prices jumped 25c per bbl. in Oklahoma, from a low of $1.10 to $1.35 per bbl.

In the east, demand for Bunker "C" fuel was much greater than for No. 2, although product was plentiful owing largely to sizeable quantities moving by tanker from California. It was estimated that by mid-January a total of about 7 million bbls. had

Information on these pages is obtained through the nation-wide news coverage service of PLATT'S OILGRAM NEWS

moved since last August from the West Coast to the East, with another 8 million scheduled for delivery by the end of next summer.

Gasoline prices eased seasonally in most areas, but declines were less than many oil men has expected. Standard Oil Co. (Ohio) made a general 0.5c per gal. cut in its prices throughout Ohio, effective Jan. 13. Reductions "reflected a current softening of prices under competitive influence," Sohio said.

Gulf cargo prices for gasoline held relatively firm, and suppliers said cargo liftings were more active than usual because of the open winter in the east.

Other price highlights in January: Lubricating oil quotations appeared to steady somewhat after a long period of declining prices for solvent refined oils. There were no major developments in crude, and top grade crude in Texas and Mid-Continent fields still commanded $2.65 per bbl. However, soft spots included heavy, high-sulfur fields in Wyoming, West Texas sour, and the Tinsley field in Mississippi.

• • •

FOREIGN

Dunkirk refinery of Societe General des Huiles de Petrole, Anglo-Iranian affiliate, will go on-stream within a few weeks at rate of 300,000 tons annually (about 6,300 b/d). Crude will come from Iran and Kuwait. Capacity of the new plant, replacing one bombed and dismantled by Nazis, is scheduled to be increased to 1,400,000 tons annually (about 29,300 b/d) by fall of 1951.

Pacific Refiners, Ltd., affiliate of Honolulu Gas Co. Ltd., will build a 3000 b/d butane-asphalt refinery in Honolulu, to be ready next June. Contract has been signed with Fish Engineering Corp., Houston. Plant will process a mixture of crude blended with butane, producing butane, gas oil, road oils and asphalts. Refined gas oil will go to the manufactured gas plant now supplying Honolulu with gas; other products will also be consumed in the Islands.

• • •

SYNTHETIC FUELS

Extension for another five years of its synthetic liquid fuels research program will probably be requested of Congress by the Interior Department and its Bureau of Mines. To finance proposed extension, the department will seek authorization for expenditures of around $35,000,000 to $40,000,000. Present program was launched in 1944 with $30,000,000 appropriation and to last for 5 years; it later was extended to 1952 with an additional $30,000,000.

Actual cost of liquid fuels from shale is now estimated by Bureau officials as being about $3.07 per bbl., or 7.3c per gal., based on a 10,000 b/d plant at the shale site. The necessary refinery realization per barrel of finished product, however, must average approximately $3.78 (9c per gal.) if all direct and indirect costs are included, and an allowance made for amortization of the $42,000,000 plant investment over a 15-year period, with annual profit after taxes of 6% on the unamortized portion.

Blaw-Knox Co. of Pittsburgh has formed a new chemicals and fuels synthesis department, to deal with the conversion of fuels into chemicals. Its work will be based initially on the Fischer-Tropsch process, according to a company announcement, and on related processes for making synthesis gas. The company has completed agreement with Ruhrchemie and Lurgi for licenses and access to all process information developed by these German firms.

• • •

PRODUCTS

SAE 60 and 70 grades of lubricating oil are to be discontinued, according to a recommendation of the Fuels and Lubricants Committee of SAE, approved at a committee meeting held during the annual SAE convention in Detroit last month. Recommendation is subject to approval of two-thirds of committee membership voting by letter ballot, and then must be passed on by SAE Technical Board. If finally approved by Technical Board, an 18-month transition period would have to elapse and then the two grades would be officially discontinued.

Octane ratings are going up, according to a survey recently completed by Du Pont Co.'s Petroleum Chemicals Division. Survey covered 35 cities in U. S. and two in Canada, and compares premium and regular grade gasolines for January of this year with May of last year. Only five cities show an average octane rating below either last May or October for premium gasoline, and only seven show a drop for regular grade rating, with all others increasing.

Average premium octane ratings in 10 cities were above 90 Research, ranging up to 91.5. Samples in only one city showed average premium rating of below 85. Average regular octane ratings were over 85 Research in four cities, and below 80 in only three.

• • •

TRANSITION

Hutex Oil & Refining Co.'s 1000 b/d skimming plant at Hardin, Texas, shut down last November, is being dismantled and sold piecemeal.

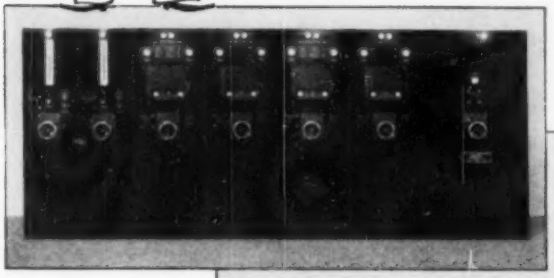
Coastal Petroleum Corp.'s 8000 b/d refinery at Mobile, Ala., has been purchased by American Bitumuls Co., Standard Oil Co. of Calif. subsidiary. An increase in plant capacity is planned.

NEW *Continuous, Automatic*

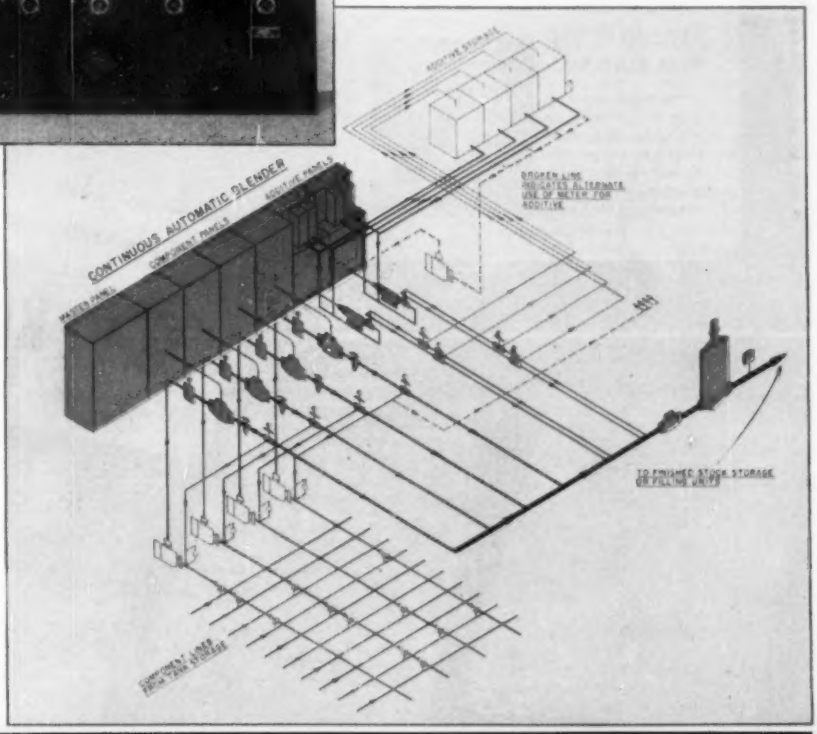
LUBE OIL BLENDER!

Achieves Greater Accuracies and New Economies in Material Handling

This new %Proportioneers% system utilizes phase control between components to reduce a complex batch compounding operation to a completely automatic continuous blending process. %Proportioneers% recirculation method permits exact presetting and control of component and additive ratios and allows quick adjustment of the total rate to production requirements without affecting these ratios. The %Proportioneers% Continuous, Automatic Lube Oil Blender makes possible greater flexibility between small and large quantity production with increased operating efficiency and new economies in material handling. For complete information ask for Brochure SM138.



Typical blender panel arrangement for four base stocks and four additives. Since each additive and component control panel is a complete unit in itself, additional panels can be readily incorporated in the assembly at any future time.



All equipment shown red in flowgram furnished by %Proportioneers, Inc.%

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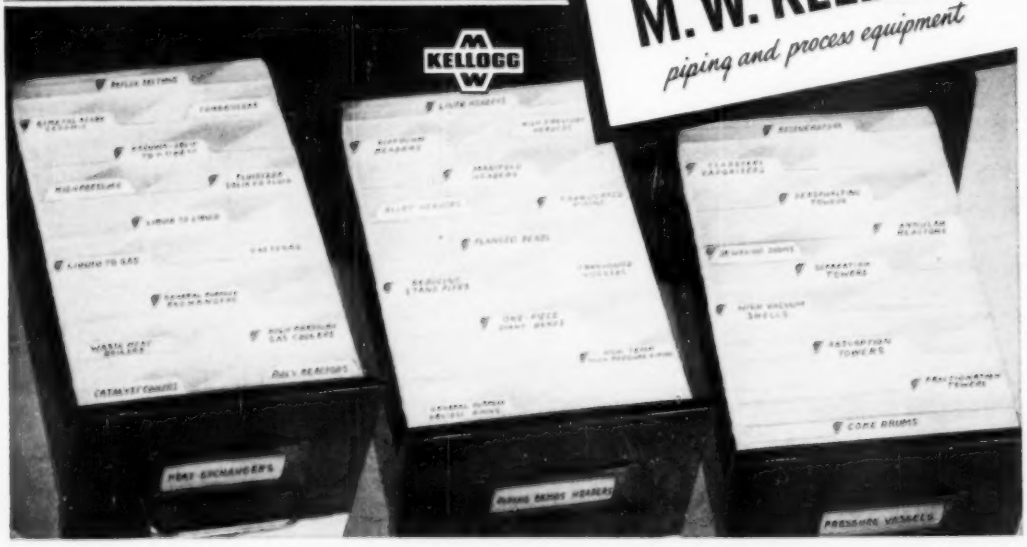

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Tomorrow

. . . IN PETROLEUM TECHNOLOGY

By B. H. WEIL, Atlanta, Ga.
Editor, "Monthly Summary of Industrial Developments"

Brief Reviews of Current Technological and Economic Developments, Reported in the Light of Their Possible Effect on Future Petroleum Processing Operations

Use of High-Additive Lubes In Gasoline Engines Studied

"WORK in the gasoline engine field to date has indicated that the special heavy-duty oil performs at least as well as any other types of lubricant. Definite advantage can be obtained as to engine cleanliness with the new oil. Excessive combustion chamber deposits leading to rapid increase in octane requirement and short spark plug life have not developed. Exhaust valve deposits have been observed, but there is no clear record that they adversely affect valve life. Our conclusions at this time are that, while gasoline engines do not require an oil of this type, some advantage may accrue to its use in certain types of service, and there seem to be no limiting factors."

These remarks in a recent ASTM paper on "Five Years' Experience With Special Heavy-Duty Oils," presented by J. A. Edgar and R. E. Jeffrey, Jr., of Shell Oil Co., bear out much that has recently been said about such oils. As regards Diesel engines, for use in which these lubricants were initially developed, Edgar and Jeffrey stated that they "have been particularly outstanding . . . where difficult fuel and operating conditions prevail. Practically all corrosive wear and engine fouling in such Diesels have been eliminated. Unsatisfactory experience with these oils in such applications is almost unknown. . . Where the oil change periods can be adjusted to fuel and operating conditions, the long-lived special heavy-duty oils normally will be more economical than any of the ordinary heavy-duty type oils."

The Armed Forces are known to be keeping in close touch with developments concerned with these high-additive oils. In a paper on "Possible Future Military Engine Oils For Ground Equipment" in which N. L. Klein, chief of the Fuels and Lubricants Section of the Ordnance Research and Development Division, recently told the ASTM that revision of U. S. Army Specification 2-104B for military lubricants is in progress, he remarked that high-additive-type lubricants, qualified by the Ordnance Department as Supplemental List 1 and Supplemental List 2 oils, might be very important in time of war because fuels and lubricants of higher sulfur contents would then probably have to be used in greater quantities.

At present, however, Klein stated that "the Army does not purchase oils from Supplemental List 1 and Supplemental List 2," although it is conducting extensive field tests, in cooperation with the CRC, to determine "advantages to be gained and any difficulties likely to be encountered . . . in present-day equipment and in engines still in the development stage. . . In consideration of higher costs and restricted availability due to the increased amount of additive required, material savings in engine maintenance and extended use of the oil in the crankcase in addition to wartime availability must be assured.

"In the absence of specific data to the contrary, it is considered that the military oils of the future for use in ground equipment will be obtained in the quality range between 2-104B and Supplemental List 1 oils. However, . . . it will be necessary first to develop additional laboratory or engine tests to evaluate such additional properties which these oils may possess."

Meanwhile, although no petroleum refiner is known to be extensively advertising high-additive-type lubricants for regular or even heavy-duty automotive use, there is a distinct possibility that this may happen soon. Many feel that oils of this type constitute the most important lubricant development in many years.

New Processes Announced For Hydrocarbon Separation

THE commercial separation of petroleum hydrocarbons into fractions of different types (aliphatic, aromatic, and naphthenic), different structures (straight- and branched-chain isomers), or different reactive properties (paraffins, olefins, and diolefins) is a subject which has received — and is receiving — concentrated attention. Fractional distillation, azeotropic distillation, processes such as hypersorption, and numerous others are much in use, with new variants constantly being developed.

According to a recent article,[1] extractive crystallization will soon be used commercially for the separation of linear aliphatic compounds from branched and cyclic analogs. "Essentially, the method consists of adding to a complex liquid mixture a material that will form a solid complex, or 'adduct,' with one or more of the components. This adduct is then removed and the desired component recovered by dissociation of the adduct with water, heat, or other means. Formation of the adduct is through physical rather than chemical means. . . .

"It is believed that urea (so far the most suitable adduct-former) permits straight-chain hydrocarbons actually to enter into its crystal lattice; branched alkane and cyclic molecules are too fat to squeeze in. . . The formation of adducts occurs with n-alkanes of from six to at least 50 carbon atoms in length."

Such extractive crystallization was "initially described at the ACS meeting this fall in a paper by W. J. Zimmerschied, R. A. Dinerstein, A. W. Weitkamp, and R. F. Marschner of the Standard Oil Co. (Ind.)." In addition, it is said that the "Shell Oil Co. has developed a continuous commercial process utilizing extractive crystallization and believes it can build a commercial plant to separate normal straight-chain molecules from others at a cost that would be at least comparable to other methods of separation. . . .

"Those who have worked on the method . . . believe it has a broad variety of potential applications in both the petroleum and chemical fields."[1]

For use in still other hydrocarbon separations, a liquid-liquid extraction column in which 50 to 60 extraction stages are said to be economically feasible has recently been exhibited by its inventor, E. G. Scheibel of Hoffman-La Roche Inc., and its manufacturer, the Otto H. York Co. It "consists of alternate calming and mixing sections in a vertical tube through which the liquid to be extracted and the extraction agent flow countercurrently (the heavier being introduced at the top).

"Mixing is accomplished by a series of agitators attached to a long shaft through the center of the tube. . . According to the manufacturer, this type of liquid-liquid extraction equipment is comparable in performance to fractional distillation equipment. The height of an extraction stage is generally lower than the height of a distillation plate. The extraction stage efficiency is said to be higher

than distillation plate efficiency."[2] Possible applications include azeotropic mixture separation, separation of structural isomers, etc.

Many processes and products of considerable economic importance to the petroleum and chemical fields depend upon the use or discovery of effective and industrially applicable methods of separating hydrocarbons from complex or even "simple" mixtures (really solutions). Use of the methods described here may prove a distinct advance in this field.

Properties of "Cold Rubber" Not as Good as Natural's

WHEN the discovery of commercial processes for producing "cold rubber" (synthetic rubber produced at 40° F. instead of 120° F.) was first widely publicized, this substance was heralded as "better than the best natural rubber" and the synthetic rubber industry's answer to the economic challenge of the vast and again-readily-available supplies of natural rubber priced at equal or even lower costs per pound. Now that the production of "cold rubber" has reached such scale that its use has been widespread and extensive, such claims are proving extravagant.

J. J. Hartz, manager of production development compounding for the Goodyear Tire and Rubber Co., recently stated that while "cold rubber" is of higher quality than GR-S, it is not as good as "good natural rubber" for all-around performance in transportation usage.[7] However, Dickson M. Sheppard of Goodyear reports[8] that "the properties of 'cold rubber' excel those of similar GR-S stocks, and its tensile strength is about equal to that of natural rubber although its ultimate elongation at high temperatures is inferior. The flex life of 'cold rubber' is better than that of standard GR-S, but inferior to that of natural rubber. 'Cold rubber' is not the equal of natural rubber in resilience and heat build-up.

"On the basis of equivalent loading, the roadwear of 'cold rubber' compounds is 23% better than that of GR-S compounds and about 15% better than that of natural rubber compounds. Tread cracking properties of 'cold rubber' are better than those of GR-S, but inferior to those of natural rubber. 'Cold rubber' is inferior to both GR-S and natural rubber in sidewall cracking and is no better than GR-S in skid resistance on icy roads.

"Mr. Sheppard further stated that the processing of 'cold rubber' does not appear to present too much of a problem. . . He expressed the belief that the future use of 'cold rubber' would be largely confined to treads for the smaller sizes of passenger-car tires and to camelback." These, incidentally, are large-volume uses.

While P. W. Litchfield, chairman of the Goodyear board, in a recent review of the rubber situation "makes the point that natural rubber has a 25% competitive advantage over synthetic rubber on a technical basis," not all within the industry believe that use will be restricted to whatever minimum quantity is made mandatory by the Government as a means of keeping enough plants in production to meet an emergency. Many feel that the recent termination of the synthetic rubber patent pooling agreement will bring forth new and better synthetic rubbers, now that competitive advantages can again be had through such developments.

Meanwhile, plants producing butadiene from petroleum are being shut down or are having their production curtailed as the demand for GR-S type synthetic rubbers, "cold" and otherwise, continues to decline. This situation, therefore, is of far more than academic interest to many within the petroleum field.

Socony-Vacuum Considering Licensing Thiophene Process

THE production of chemicals from petroleum is by no means a simple matter economically, no matter how well developed the process employed. A recent item in *Chemical and Engineering News*[6] bears testimony to this fact:

"After producing thiophene on a trial basis for several years, Socony-Vacuum stopped making it last spring because the field appeared to be too specialized for an oil company. One use for thiophene is in the synthesis of certain antihistamines, and the rash now developing in the antihistamine market has brought pressure on Socony-Vacuum to go back into the business. The company, however, has made flat and final decision not to return to thiophene production and is now negotiating with a chemical firm to license the process."

News items such as this provide occasions for sober reflection. No petroleum company should ever consider the manufacture of a chemical from petroleum unless the marketing of this chemical is assured, its production is particularly economic, its manufacture is part of a series or group of syntheses, etc.

Socony's reasons for not resuming thiophene manufacture are beside the point here; however—and this is not to be forgotten—Socony was not necessarily "wrong" in having entered into thiophene production in the first place. Few new chemicals have ready-made volume markets, yet some companies have profited greatly by developing uses and users for their products. If all this sounds confused, it is no more so than the petrochemicals field seems, even to those who have studied it extensively.

Expanding Market Is Seen For Acrylonitrile in Fibers

ACRYLONITRILE, a chemical introduced commercially in this country only ten years ago, has recently come in for concentrated attention. Previously used almost exclusively for copolymerization with butadiene in the manufacture of the GR-N (Buna-N) type of synthetic rubbers, this compound now is expected to find large-volume application in the field of synthetic fibers.

Du Pont, at present, is hard at work on the construction of a commercial plant to produce "Orlon," said to be an all-acrylonitrile-polymer fiber with properties which rival or excel many of those of nylon, yet which does not cost as much to manufacture. The Chemstrand Corp. is also known to be interested in the production of acrylonitrile-type fibers, although commercial production by this company is said to be at least two years away; blends of such fibers with nylon and wool are currently under study.

"Dynel," the "new" fiber of the Carbide and Carbon Chemicals Corp. which was previously marketed under the name of "Vinyon-N" to distinguish it from the original Vinyon copolymers of vinyl chloride and vinyl acetate, is also an acrylonitrile derivative, in this case a copolymer with vinyl chloride. A recent booklet[3] describing it, incidentally, states that it is "characterized by the following properties: high resilience, warmth, mothproofness, dimensional stability, rapid drying, wet and dry strength, resistance to combustion—self extinguishing, resistance to acids and alkalies, mildewproofness, and dyeability with acid or acetate dyestuffs."

At present, American Cyanamid Co. is said[4] to be the sole producer, but "expansion (of production) or entry into the field by new producers is a likely bet." Several petroleum companies are known to be interested in its production,[5] and much more will certainly be heard of this "chemical from petroleum."

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(1) Anon., "Go, No-Go for Liquids," *Chemical Industries*, 65, No. 5, 709 (1949).
(2) Anon., "Mixer-Calmer," *Chemical Industries*, 65, No. 5, 708 (1949).
(3) Anon., *Technical Information — Dynel*, Carbide and Carbon Chemicals Corp. Publication F-7427, New York, 1949, 6 pages.
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(5) D. P. Thornton, Jr., "Processes for Making Nitrile Compounds Patented by Three Oil Companies," *National Petroleum News, Technical Section*, 38, No. 10, R-221—R-224 (1946).
(6) Anon., "Concentrates—Thiophene Comeback," *Chemical and Engineering News*, 27, No. 50, 3681 (1949).
(7) Frank Baker, "'Cold Rubber' Excels GR-S, but Not Nature's," *SAE Journal*, 57, No. 12, 86 (1949).
(8) Anon., "Scientific and Technical Activities," *India Rubber World*, 121, No. 3, 319 (1949).

STOP RUST

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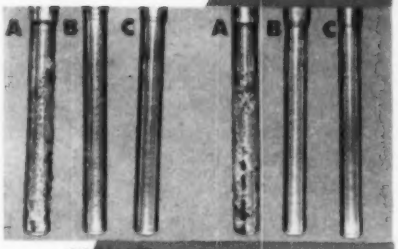
SANTOLENE C



GASOLINE FUEL OIL

Concentrations of Santolene C in tests with light petroleum products are as follows: (A) No Santolene C, test failed; (B) 10 ppm. Santolene C effective, but test failed; (C) 20 ppm. Rust absent. Test passed.

PHYSICAL PROPERTIES OF SANTOLENE C

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Viscosity at 210° F. SUS	52
Pour Point °F	—30
Sp. Gr. 60/60° F.	.884
Pounds per gallon	7.36

The rust problem, in transportation and storage of light petroleum products, is solved by Monsanto's Santolene C. Laboratory tests, results of which are illustrated in the photograph, give evidence of the effectiveness of Santolene C.

Santolene C, effective when used in small quantities, is economical, costing only about 0.14 cents to inhibit rust in a 42-gallon barrel of gasoline or oil. Concentrations up to .01% of Santolene C have no noticeable effect on the usual specification items for gasoline, kerosene and No. 2 fuel oil, with the exception of ASTM glass dish gum on gasoline at higher concentrations. Here the increase in gum was only about 1 mg. per 100 cc. per 0.002% of Santolene C. Santolene C is available . . . now . . . in commercial quantities.

If you would like to put Santolene C over the hurdles in your laboratory, we shall be glad to send you a sample. For further information, mail the coupon or write: MONSANTO CHEMICAL COMPANY, Desk A, Petroleum Chemicals Department, 1746 South Second Street, St. Louis 4, Missouri.

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How Tide Water Oil Uses

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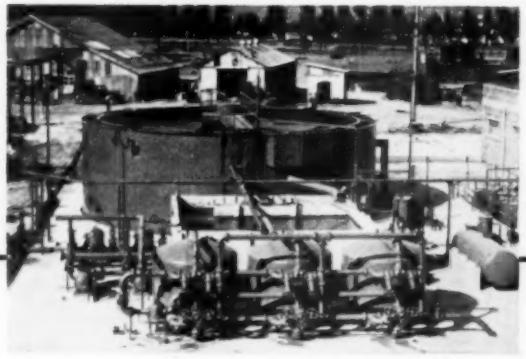

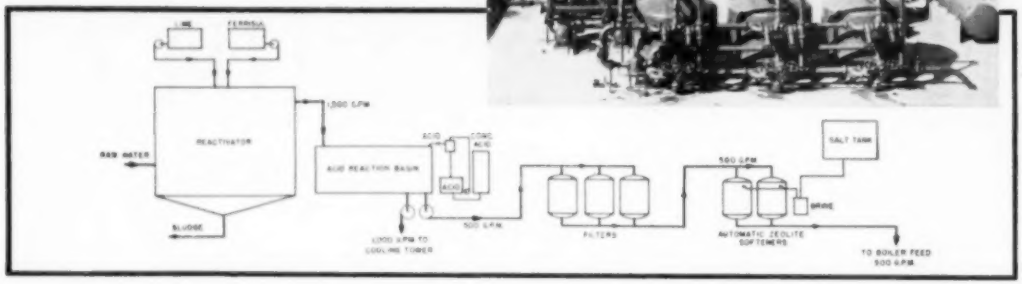

At Tide Water Oil Company's Avon, California, refinery a turbid hard water supply is completely conditioned for boiler feed and cooling water services by Graver equipment consisting of Reactivator, Acid Feeding System, Anthrafilt Filters and Automatic Zeolite Softeners as shown in the flow chart above.

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The Graver Acid Feeding System continuously and automatically proportions acid to the Reactivator effluent to reduce the alkalinity and to correct the pH to the desired value. Part of the water is thus conditioned for the cooling water system. The remainder of the water is filtered in the Graver Anthrafilt Filter and softened to zero hardness in the Graver Zeolite Softener for use as boiler feedwater.

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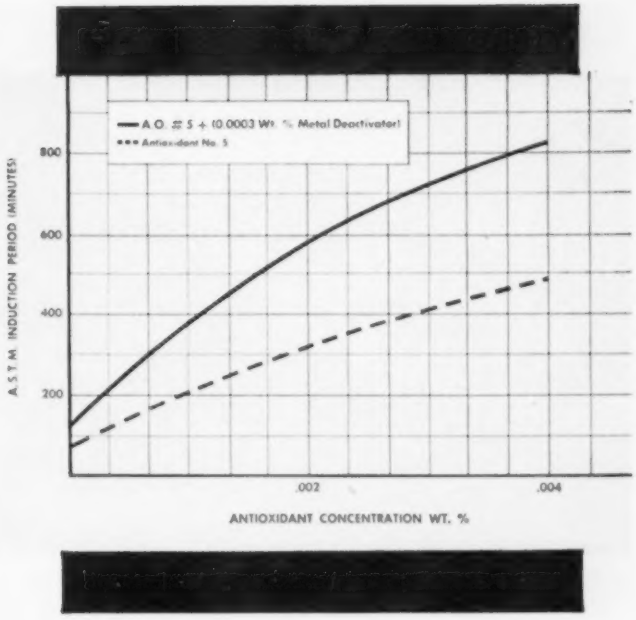
Case History:

This chart shows improvement in induction period on thermally cracked stock containing 0.6 parts per million of copper when using Du Pont Metal Deactivator in combination with Du Pont Gasoline Antioxidant No. 5, compared with use of antioxidant alone.



Du Pont Metal Deactivator Reduces Antioxidant Treating Costs of Copper-Contaminated Fuel By 35%

Copper, if present in your gasoline in even trace quantities, may be costing you money through greater antioxidant requirements than necessary. Du Pont Metal Deactivator is the answer to such a problem because, in every case, overcoming the catalytic effect of copper is more economical with Metal Deactivator than an attempt at stabilization with antioxidants alone; and the gasoline containing Deactivator is more stable in storage.

This particular case history shows how in one refiner's copper-contaminated stock the addition of a relatively small amount of Du Pont Metal Deactivator resulted in marked antioxidant savings.

The base stock, a thermally cracked gasoline, contained 0.6 parts per million of copper. Du Pont Gasoline Antioxidant No. 5 was found to be the most effective of the three Du Pont antioxidants and a concentration of .0036 wt. % was required to obtain an induction period of 460 minutes. However, with the addition of only 0.0003 wt. % of Du Pont Metal Deactivator it was possible to obtain a 460 minute induction period with an antioxidant concentration of .0014 wt. %—a reduction in antioxidant treating costs of thirty-five per cent.

If you are not presently using Du Pont Metal Deactivator, you should check this product because copper is apt to be present when least suspected. The nearest Du Pont District Laboratory will be glad to run a Metal Deactivator test on your stocks for you. Call your DuPont Petroleum Chemicals representative.

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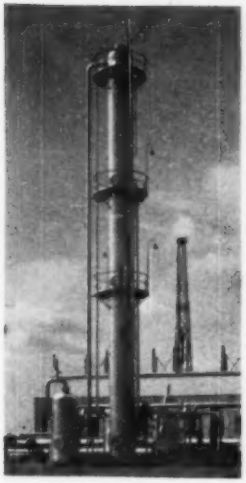
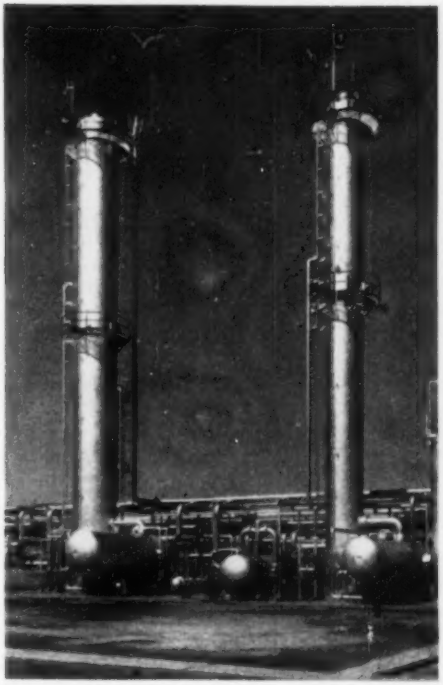
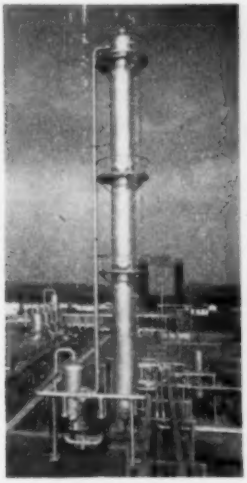


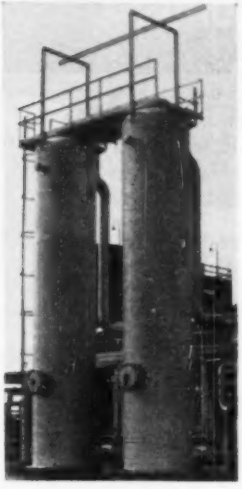
Above: The 5-ft. diam. by 79-ft. 3-in. Absorber Tower and a 5-ft. diam. by 10-ft. Residue Gas Scrubber at the Lindsay, Oklahoma plant.



Left—A 6-ft. diam. by 80-ft. 6-in. high de-ethanizer. Right—A 8-ft. diam. by 90-ft. 6-in. high de-propanizer. Both are at Maysville, Okla. Commercial propane is taken from the de-propanizer overhead.



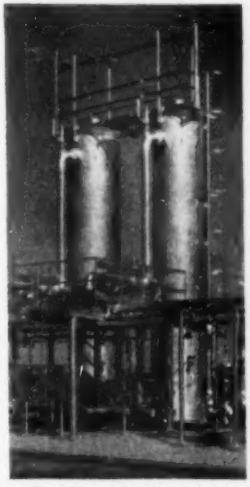
The 5-ft. diam. by 79-ft. 3-in. Absorber Tower and a 5-ft. diam. by 10-ft. Residue Gas Scrubber at the Antioch, Oklahoma plant.



Two 5-ft. 6-in. diam. by 25-ft. 6-in. Dehydrator Chambers at the Lindsay, Oklahoma plant for dehydrating absorber residue gas.

Economical recovery from small pools made possible by operating three plants as a single integrated unit

The Warren Petroleum Corporation uses a novel method to put small pools at Antioch and Lindsay in Oklahoma on a sound economic basis. The Antioch and Lindsay plants operate as compressor and remote absorption units. The enriched oil from these two absorbers is piped to a nearby processing plant at Maysville which produces natural gasoline, butane, and propane. In addition to the equipment illustrated, we also furnished 39 pressure storage tanks, 2 dehydrator towers, 1 absorber tower and 1 raw gasoline surge tank for these three plants. The same skill and the same facilities used in building this equipment are available to you. Simply write our nearest office for details.



Two 5-ft. 6-in. diam. by 25-ft. 6-in. Dehydrator Chambers for dehydrating total raw gasoline production at Maysville, Oklahoma.

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Houston 2 . . . . . 2130 National Standard Building
Havana . . . . . 402 Abreu Building
Los Angeles 14 . . . . . 1526 General Petroleum Building
New York 6 . . . . . 3310-165 Broadway Building
Philadelphia 3 . . . . . 1630–1700 Walnut St. Building
Salt Lake City 1 . . . . . 530 West 17th South Street
San Francisco 11 . . . . . 1259–22 Battery St. Building
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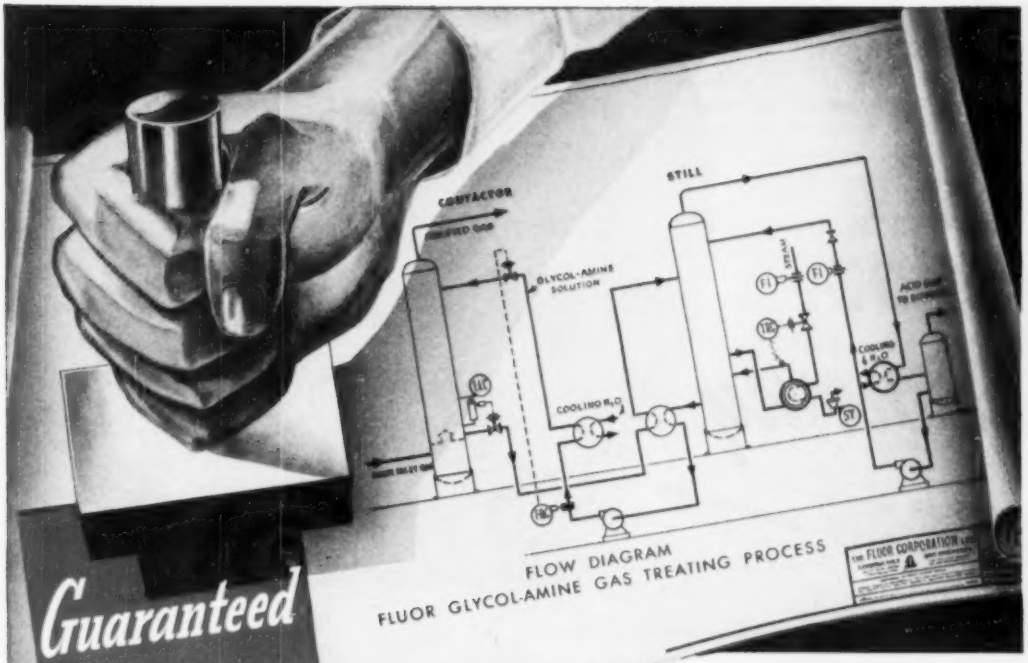

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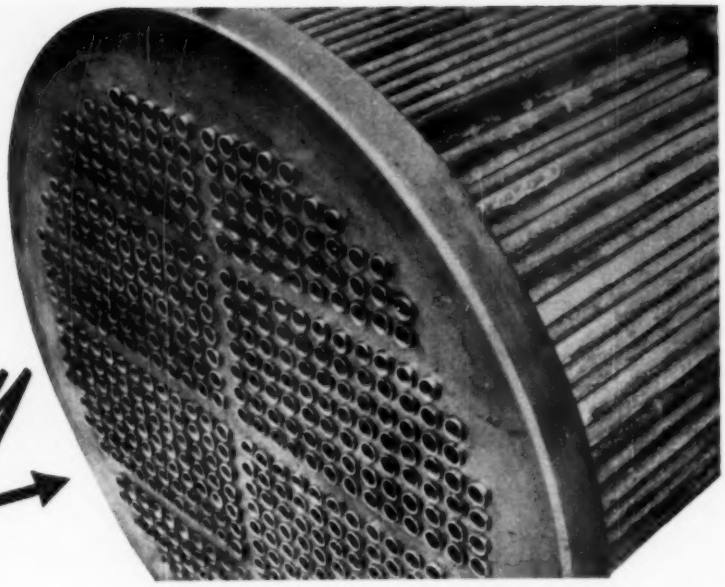

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For further information and prices on Lukens Monel-Clad Steel, write directly to the Lukens Steel Company, 524 Lukens Building, Coatesville, Penn.

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*Additional copies of this advertisement available on request.

Because of the numerous requests for reprints of page 15 in our Centrifugal Pump Bulletin 106 we reproduce it herewith*...

NET POSITIVE SUCTION HEAD

(Symbol NPSH)

A liquid can neither be "pulled" nor "sucked," but it must be forced by pressure into the impeller of a centrifugal pump. The term NPSH has been adopted to designate the pressure required to force a given number of gallons per minute of liquid into the impeller of a pump. For uniformity, NPSH is expressed as the head in feet of liquid equivalent to the required pressure in psi. over and above the vapor pressure of the liquid at the pumping temperature.

Each pump has its individual NPSH characteristics which are shown by the performance curve submitted by the pump manufacturer. The NPSH at any point on the curve is the head in feet of liquid equivalent to the pressure in psi. required to force the liquid through the passages from the suction flange to a point in the impeller where it is picked up by the vanes. The required NPSH shown on performance curves is based on actual tests and for the convenience of the plant design engineer, the values shown on the curves are corrected to the centerline of the pump.

The plant design engineer must locate the pump and design the suction piping so that the system NPSH available at the pump is equal to or greater than the NPSH required by the pump. An adequate system NPSH is necessary for the pump to deliver its rated capacity and to prevent cavitation. The system NPSH available at the pump may be calculated by the following formulae:

1. For a pump located above the level of the liquid to be pumped—

$$\text{System NPSH} = \frac{(P - Pv)\ 2.31}{\text{Sp. Gr.}} - (Z + H_f + H_e)$$

2. For a pump located below the level of the liquid to be pumped—

$$\text{System NPSH} = Z + \frac{(P - Pv)\ 2.31}{\text{Sp. Gr.}} - (H_f + H_e)$$

Where . . .

Z = Vertical distance in feet from the centerline of the pump to the level of the liquid.

P = Pressure on the surface of the liquid in p.s.i.a.

Pv = Vapor pressure of the liquid at the pumping temperature in p.s.i.a.

Sp. Gr. = Specific Gravity of the liquid at the pumping temperature.

H_f = Friction loss in feet head through suction pipe and fittings.

H_e = Loss of head in feet at entrance to suction pipe.

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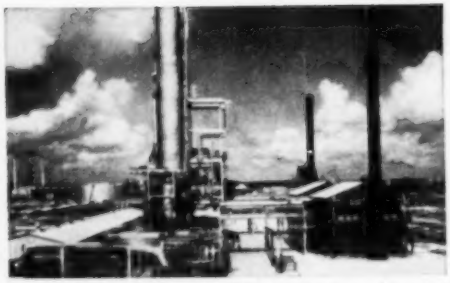
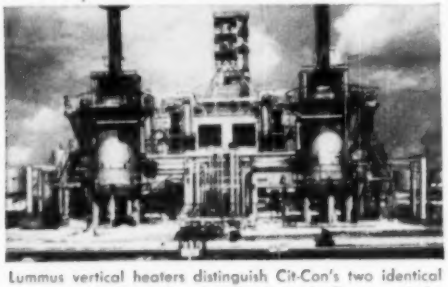
Cit-Con widens Lube-Oil horizons

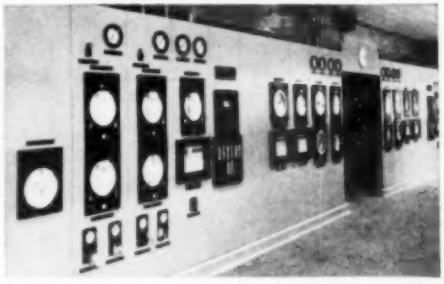


Cit-Con's "twin" vacuum distillation units shown here can each handle 12,500 barrels a day of reduced crude. Design provides over-capacity to produce a higher proportion of neutral oils to bright stock when required.



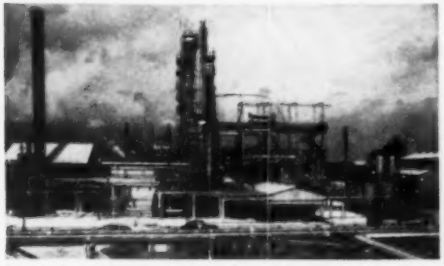
Lummus vertical heaters distinguish Cit-Con's two identical clay contact plants. One handles light distillates; and the other, heavy distillates and bright stocks.

The new Cit-Con lubricating oil plant at Lake Charles, La., is an outstanding example of Lummus' design and construction. From the beginning, the project kept pace with pre-planned schedules. Currently, operations and products are meeting the most modern standards.

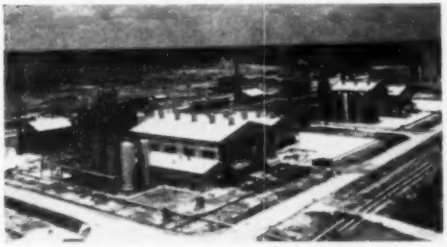


Vacuum units have a common, streamlined control room. This view shows instrument board and instruments for both of the distillation units.

This air view shows the L-shaped layout of the processing units. From right to center foreground can be seen, in order: vacuum distillation units, solvent refining units, and the boiler house in the corner. Continuing to the left around the L are the two MEK dewaxing units, the clay contact plant, and the wax finishing unit.



The furfural extraction unit is of exceptionally high capacity with two stages of furfural recovery on the raffinate system and four stages on the extract system. The solvent circulation rate is 30,000 barrels daily.



This general view shows in close-up, from left to right, MEK dewaxing units No. 1 and 2, and the clay contact plant. The No. 1 MEK plant for light distillates has recrystallization facilities which may be equipped later for incremental dilution. The other plant for heavy intermediate distillate and bright stock is presently equipped with repulping facilities to reduce oil content of the amorphous type wax.

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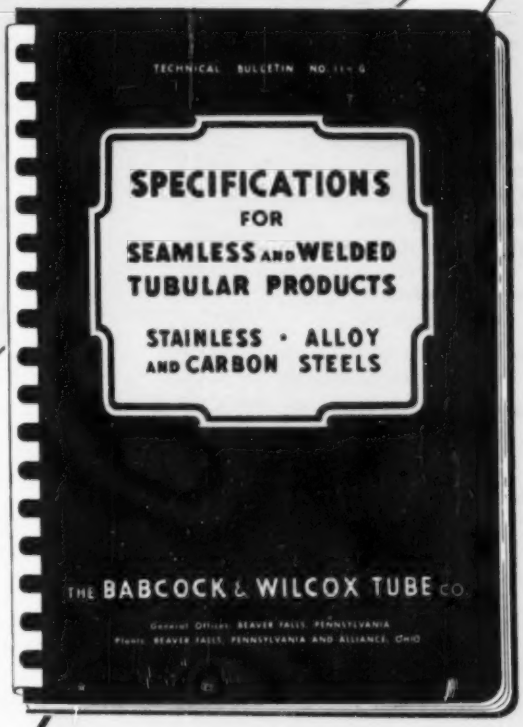

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Type No.	Chromium	Nickel	Carbon	Other Elements
301	16-18	6- 8	Over .08-.20	
302	17-19	8-10	Over .08-.20	
302B	17-19	8-10	Over .08-.20	Si 2-3
304	18-20	8-11	.08 max.	
308	19-21	10-12	.08 max.	
309	22-24	12-15	.20 max.	
309S	22-26	12-15	.08 max.	
309Cb	22-24	12-15	.10 max.	Cb 8xC min.
310	24-26	19-22	.25 max.	
314	23-26	19-22	.25 max.	Si 1.5-3
316	16-18	11-14	.08 max.	Mo 2-3
316Cb	16-18	10-14	.08 max.	Mo 2-3; Cb 8xC min.
317	18-20	11-14	.08 max.	Mo 3-4
321	17-20	9-13	.08 max.	Ti 5xC min.
329	23-28	2.5-5	.20 max.	Mo 1-2
330	14-16	33-36	.15 max.	
347	17-20	9-13	.08 max.	Cb 10 x C min.
403	11.5-13		.15 max.	
405	11.5-13.5		.08 max.	Al .10-.30
410	11.5-13.5		.15 max.	
416	12-14		.15 max.	P, S, Se min. .07 Zr, Mo max. .60
430	14-18		.12 max.	
443	18-23		.20 max.	Cu .90-1.25
446	23-30		.20 max.	N_2.10-.25
Inconel*	11-15	70 min.		Fe 10 max.
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CHROMIUM, nickel, carbon, manganese, silicon, molybdenum, columbium, titanium — these and other elements, combined in various percentages, are the ingredients of stainless steel. Because varying analyses have widely varying service characteristics, Globe recommends a specific analysis or type only after carefully studying your particular problem. In addition to the above 26 standard types, *Globe also furnishes special analyses.*

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Write for Bulletin 301 — Corrosion and Heat Resisting Steel Analyses Chart — a valuable reference tabulation of stainless steel analyses as produced by various manufacturers.

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The ABC's of Powell Valve PERFORMANCE

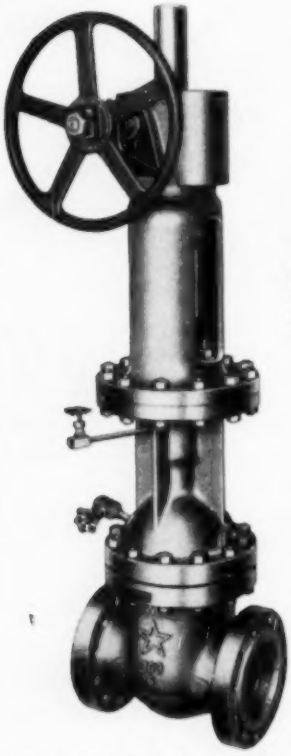

Fig. 3003 S. S. Mod.—Class 300-pound Cast Alloy Steel Gate Valve for ultra-high temperatures. Has cooling fins to reduce temperature in the stuffing box. Bevel gear operated.

Fig. 1460—Iron Body Bronze Mounted "Master Pilot" Gate Valve, with screw ends, rising stem, bolted flanged bonnet and tapered solid wedge.

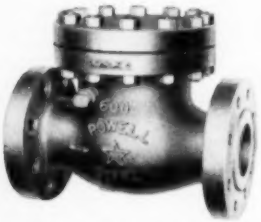

Fig. 6061—Class 600-pound Cast Steel Swing Check Valve with flanged ends and bolted cap. Disc has ample lift to permit full, straightway, unobstructed flow through valve body.

Fig. 1375—200-pound Bronze Gate Valve with screwed ends, inside screw rising stem, union bonnet and renewable, wear-resisting "Powellium" nickel-bronze seat rings and disc.

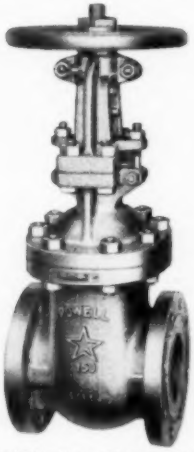

Fig. 1503—Class 150-pound Cast Steel Gate Valve with flanged ends, outside screw rising stem, bolted flanged yoke, tapered solid wedge.

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Globe Boosts Capacity With Fluid Cat Cracker

By G. G. Woodruff
Secretary, Globe Oil & Refining Co.

By replacing a thermal cracking plant with the most modern type of fluid catalytic cracking unit and a gas concentration system, a major step has been taken in expanding the motor fuel producing capacity of our refinery at Lemont, Illinois, and substantially improving the octane rating of our gasoline.

G. G. Woodruff

The flexibility of the cat cracker also enables us to increase the yield of other light products, notably domestic furnace oil and diesel fuel, for which there is a growing demand. Production of heavy fuel oil, which is less desirable, has been reduced. With these improvements our refinery is in position to meet not only present octane requirements, but those anticipated in the forseeable future.

Unit Designed by Universal

When the installation of catalytic cracking facilities was first under consideration, all available processes were investigated from the standpoints of construction cost, yield and quality of gasoline and other products to be obtained. After thorough study, the design and engineering of the new facilities were entrusted to Universal Oil Products Company. The new unit, with a design capacity of 6,000 b/d, was placed on stream in early January.

Our Overall Operation

About 9,000 b/d of a mixture of West Texas, Wyoming and Gulf Coast crudes are charged to a combination atmospheric and vacuum distillation unit which produces about 2,800 b/d of gas oil. Approximately 22,000 barrels of a mixture of Illinois, Kansas and Gulf Coast sweet crudes are charged to a combination topping and gas oil cracking unit which produces about 3,200 barrels of a mixture of straight-run and cracked gas oils. The two gas oil streams, amounting to 6,000 barrels, are cracked in the new unit.

The overall refinery operation, including topping, cat cracking, desulfurization, thermal reforming and catalytic polymerization, produces about 17,800 b/d of gasoline or approximately 1,000 barrels more than was produced prior to the installation of the cat cracker. About 7,000 barrels of this gasoline are brought to Ethyl grade with 0.6cc of lead as compared to 1.8cc which we formerly used, while 10,800 barrels are marketed as housebrand gasoline with the addition of 1.1cc of lead. Other pro-

(Advertisement)

ducts are kerosene, diesel fuel, tractor fuel, furnace oil, heavy fuel oil, asphalt and road oil.

Here is a comparison of the yield from our old thermal unit and that which we expect from the fluid unit:

	Thermal Cracking		Catalytic Cracking (50% Conversion)	
	Bbl.	%	Bbl.	%
Gasoline (C_5 to 400°F)	1680	27.9	2860	47.8
Light fuel	1020	17.0	1800	30.0
Heavy fuel	3220	53.6	1200	20.0
Gas (Fuel oil equiv.)	186	3.1	440	7.3

The cat cracker is of the general UOP design with the reactor supported by a skirt set on the regenerator and with the stripper hung from the side of the reactor. The new graphic type control board, developed by UOP will be installed.

Low cost and reliable electric power is available to Globe, hence motor drives are used for the air blower and the gas compressors, as well as for most of the pumps. This results not only in lowered utility costs but also in a decrease in capital cost and maintenance.

Steam is used by the process for stripping catalyst and side cuts. This is exhaust from the main column bottoms circulating pump – the only turbine driven pump on the unit. A small amount of reboiler steam is also used for a few small reciprocating pumps and for a small reboiler in the gas recovery unit.

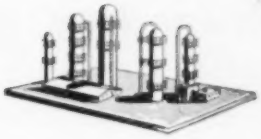
The Gas Concentration System

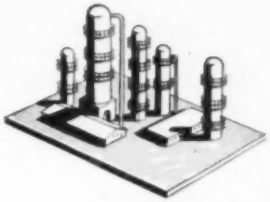
Steam is generated from waste heat in the regenerator flue gas and the column bottoms. After furnishing steam to the catalytic cracking and gas recovery units, about 10,000 lb./hr. is supplied the refinery for use in crude and vacuum units. The gas concentration system is of the deethanizer type. Its two functions are the preparation of feed for the catalytic polymerization unit and the debutanization of catalytically cracked gasoline; hence, it is designed for maximum recovery of propane.

The system consists of a compressor section, a deethanizer and a debutanizer. Two existing towers were adapted to the deethanizer service.

In operation, the gas from the catalytic cracker receiver is compressed in two stages to 200 lb. per square inch and is charged to an absorption type deethanizer. The overhead from this tower is ethane and lighter gas which is discharged to the fuel gas line. The bottoms are charged to the debutanizer which operated at 150 lb. pressure. The debutanizer overhead is composed of C_3-C_4 fractions, which constitute the charge to the poly unit. The bottoms normally are debutanized gasoline. The unit is designed for very high heat efficiency, reboiler requirements being supplied almost entirely by heat exchange from a cat cracker side-cut and debutanizer bottoms.

(Advertisement)





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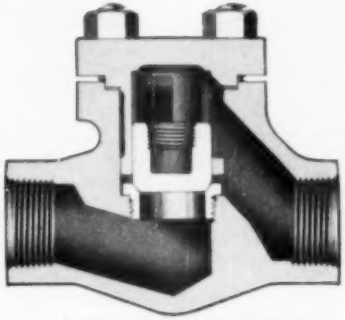

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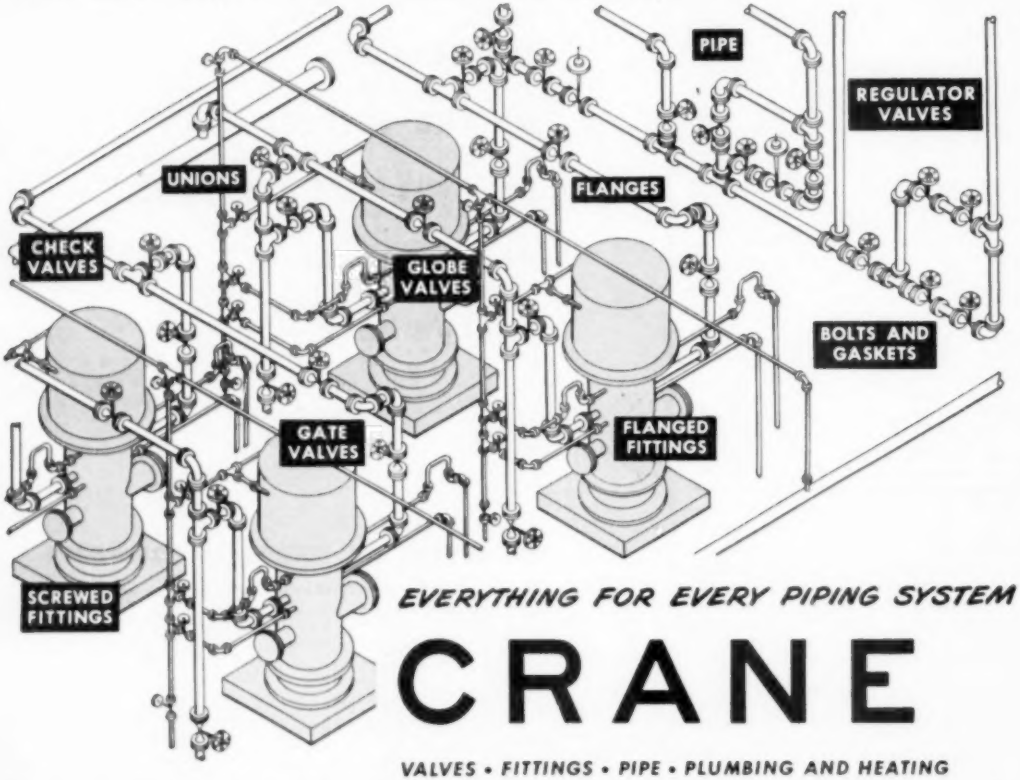

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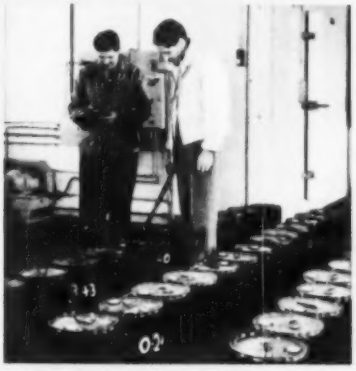

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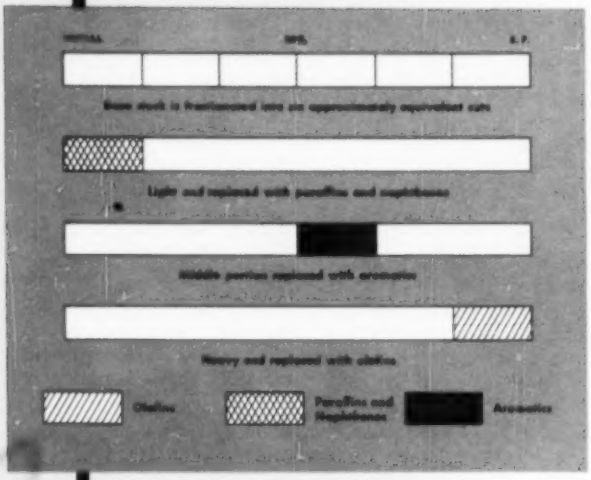
Studying the Effects of Fuel Hydrocarbon Types on Road Antiknock Performance

As a service to the refining industry, Du Pont is now engaged in a program of fuel research designed to help provide answers to such questions as: how should fuel blending stocks rich in aromatics, naphthenes or other hydrocarbon types be blended to provide optimum fuel performance—where and how should they be blended to make most efficient use of tetraethyl lead compounds. This research project is devoted to studying the effects of fuel hydrocarbon types on road antiknock performance and is one of the most extensive of its type ever undertaken. Work on this study is now in progress and results will be available in the near future to assist refiners in their gasoline production.

Du Pont, as a supplier of tetraethyl lead compounds to a constantly increasing number of refiners, is working with the refining industry toward the common goal of improved gasolines for the motoring public at the lowest possible cost. Du Pont Petroleum Chemicals research is aimed at improving antiknock compounds and helping the refiner utilize present tetraethyl lead compounds most efficiently.



EXAMPLES OF HOW DIFFERENT HYDROCARBON TYPES ARE BLENDED TO PRODUCE EXPERIMENTAL FUELS

Working to help the refiner blend for the best possible utilization of TEL

As a starting point in the present Du Pont study of the effects of fuel hydrocarbon types on road antiknock performance a good quality regular grade gasoline was fractionated into six approximately equivalent cuts. Then each fraction was replaced systematically with pure hydrocarbons of three types (1) olefins, (2) paraffins and naphthenes and (3) aromatics (where possible). The components used in making these blends were selected so that the volatility of the finished blends was changed as little as possible and the research octane numbers of the unleaded blends were constant within plus or minus five units. The resulting blends, both clear and containing various amounts of TEL are being road knock tested in current model cars typical of the great majority on the road as well as in cars equipped with high compression ratio research engines. Thus data are being obtained on both present day and future requirements.

Such information will provide a better understanding of: (1) the effect on road antiknock performance and lead response of gasoline hydrocarbon type and position in the fuel boiling range and (2) the effects of engine design and compression ratio on the relative performance of basically different fuels. This project has a very practical value to the refiner because it will give him leads as to how he can best blend his stocks and make the best possible utilization of tetraethyl lead.

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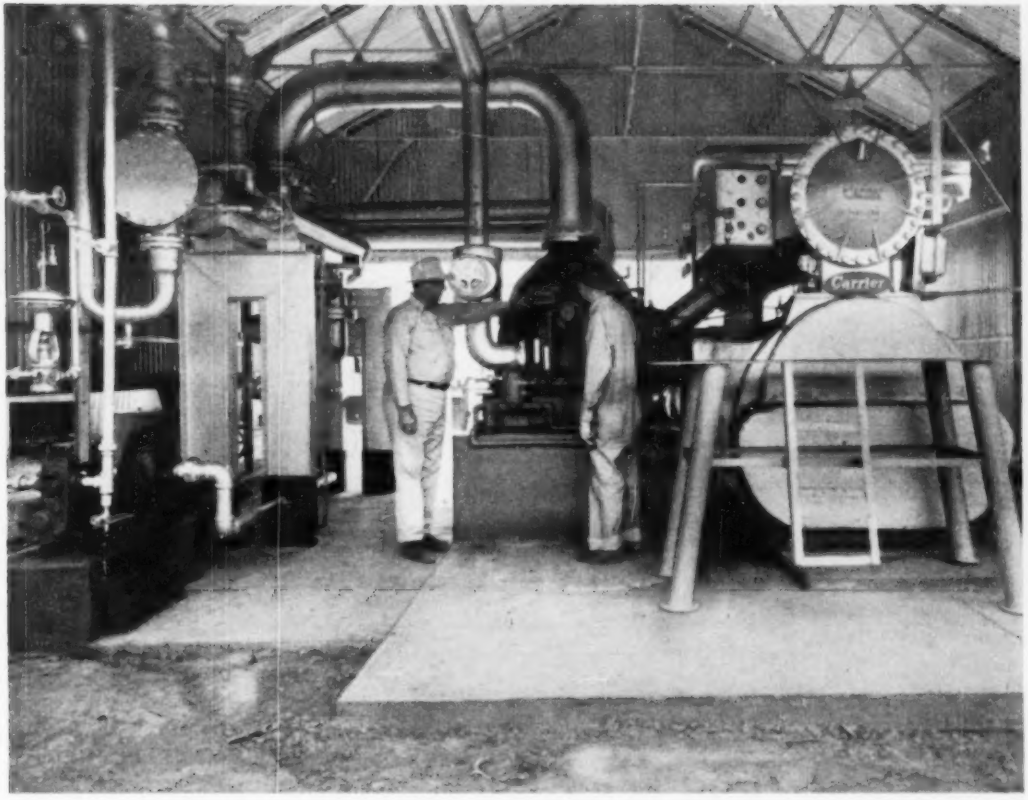

Warren Petroleum Corp. increases propane-butane recovery 7000 gallons daily with Carrier Centrifugal machine

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Superintendent says, "Carrier refrigeration unit increases propane extraction by 10%... butane extraction 7%"

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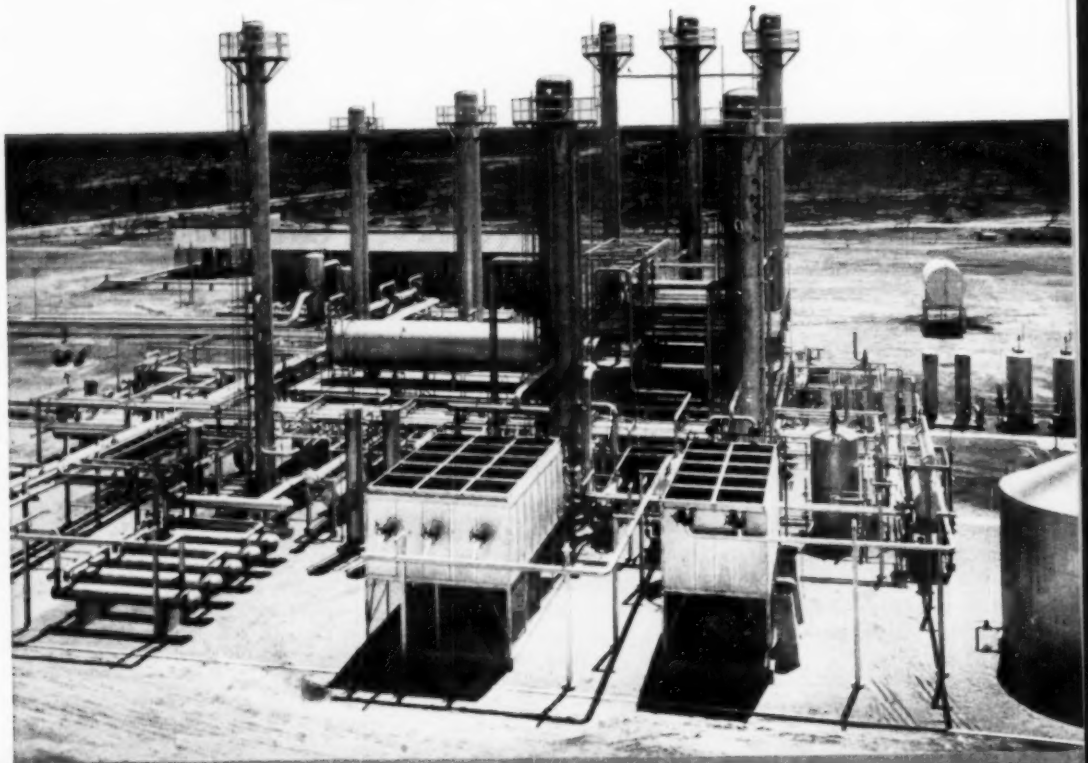

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all 3 types are in this installation

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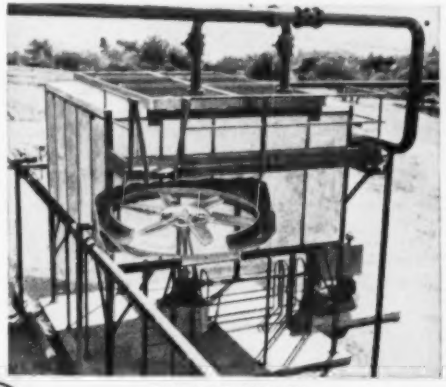

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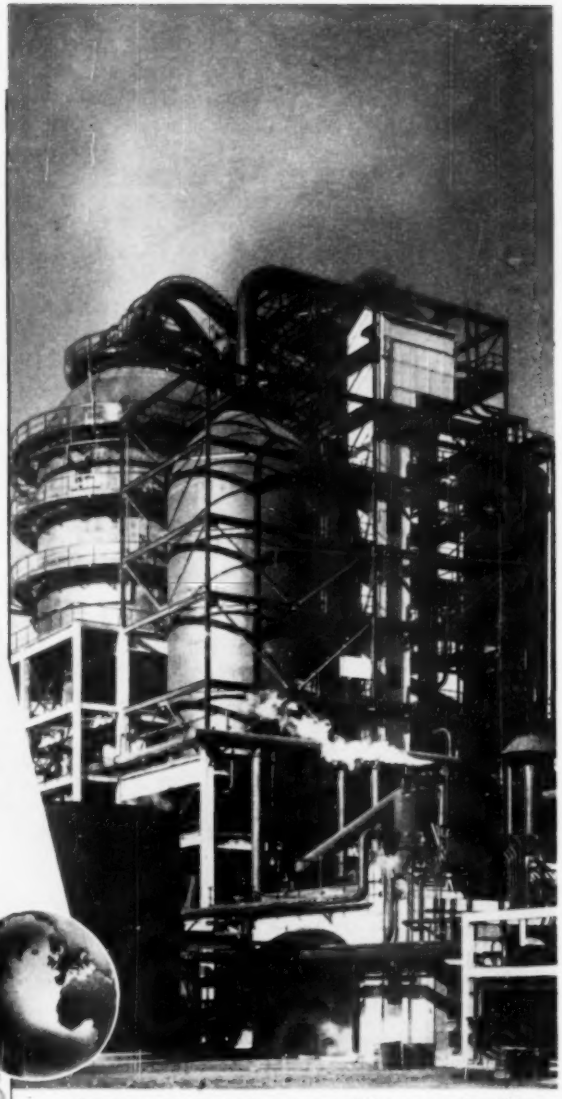

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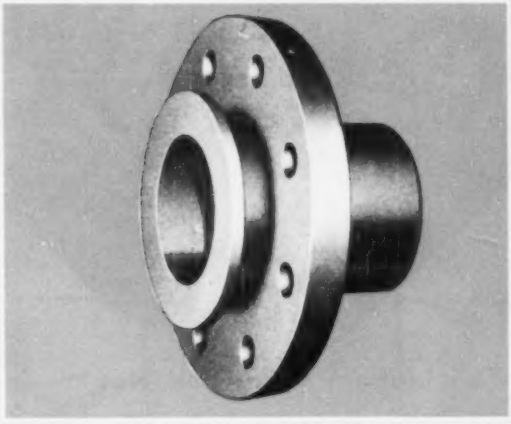

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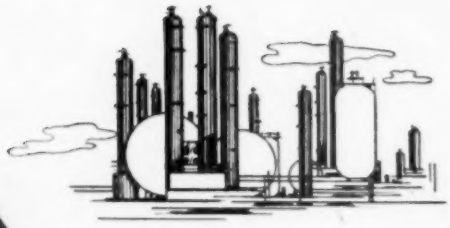

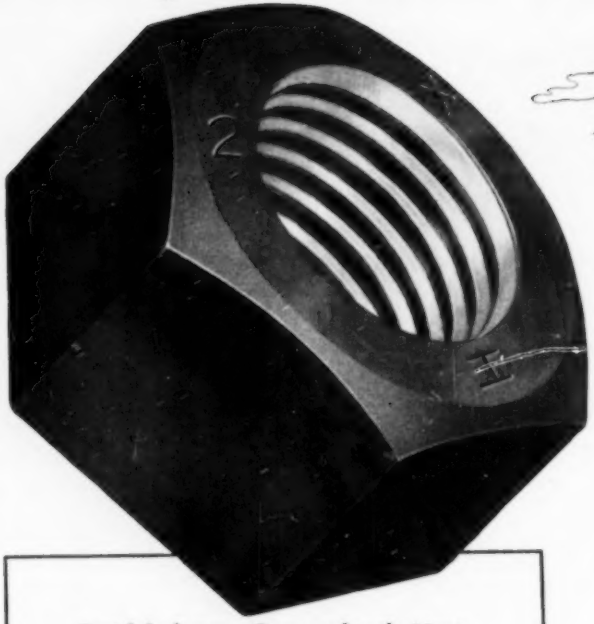

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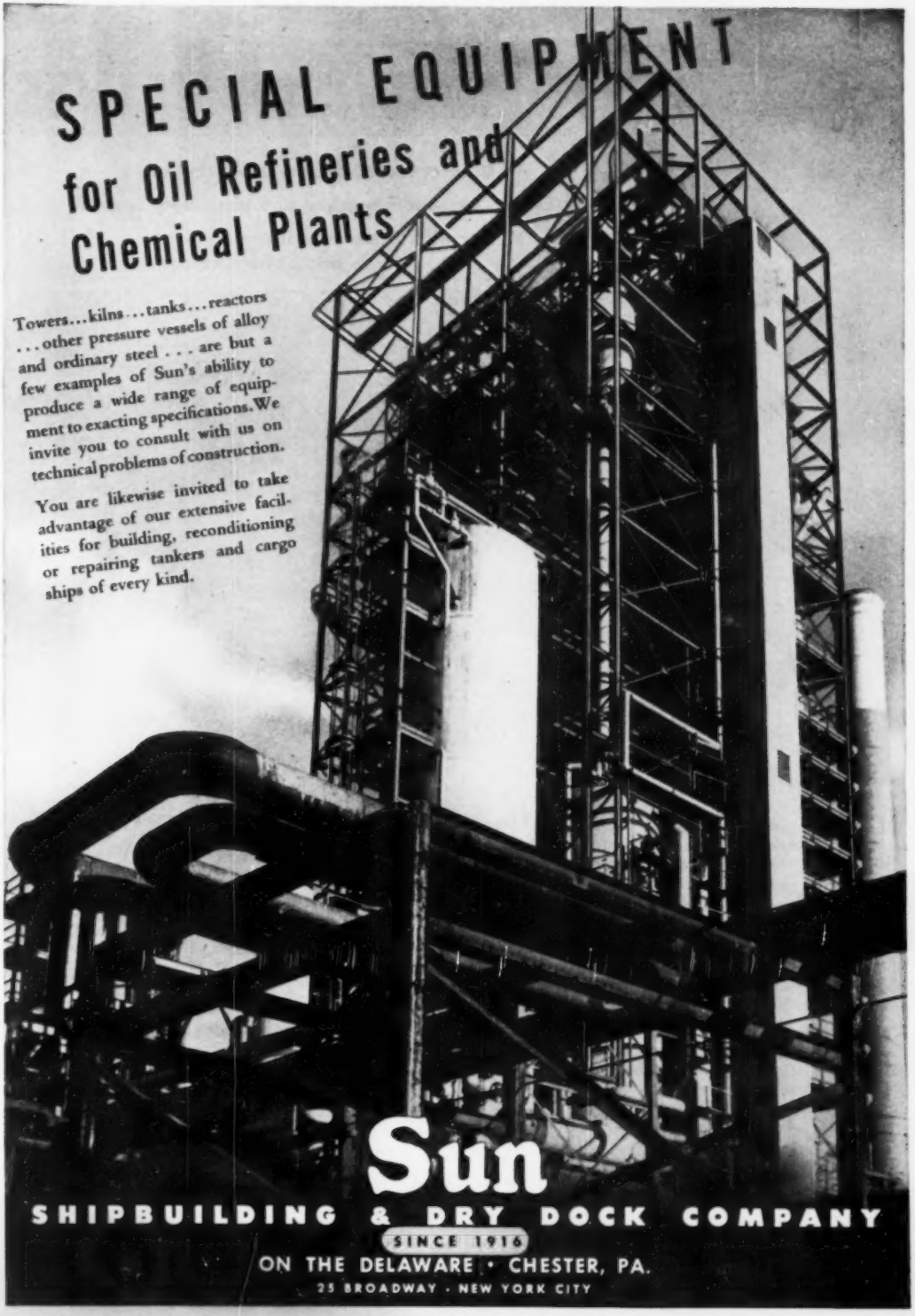

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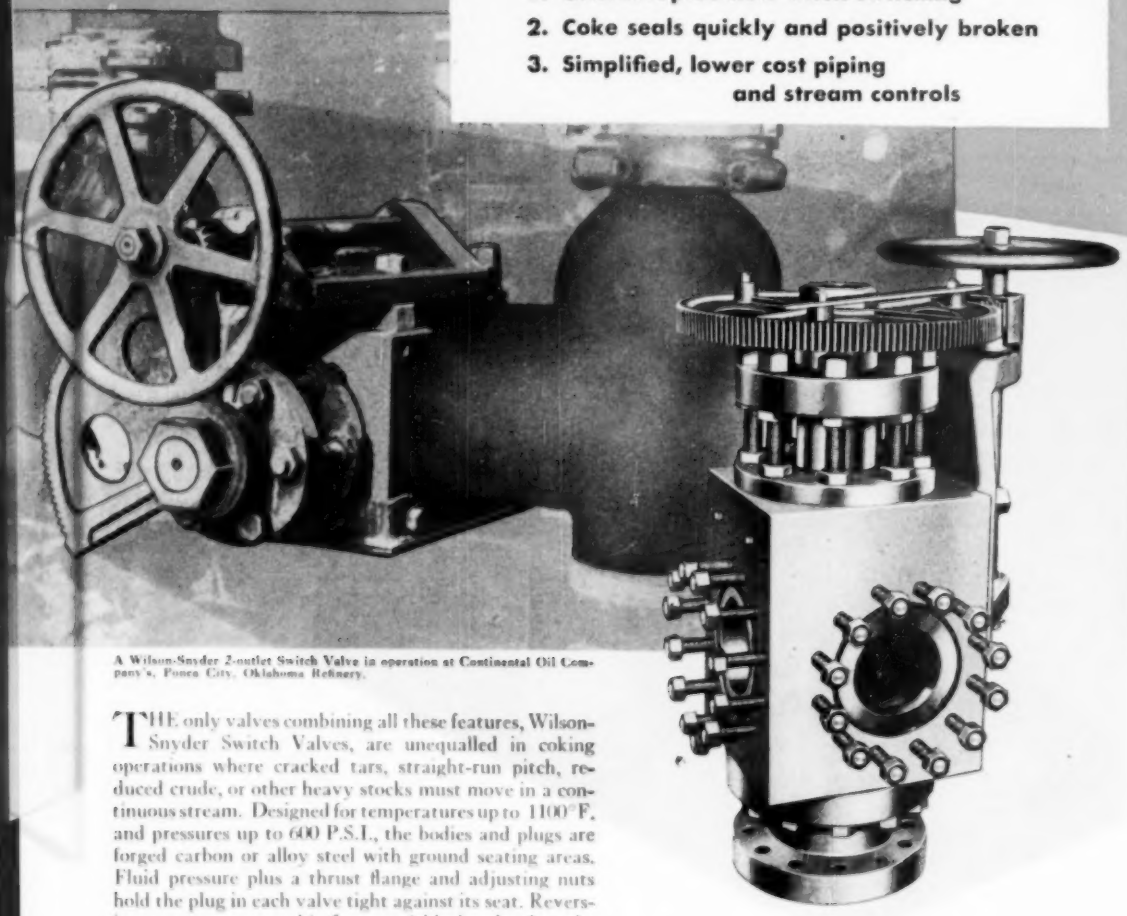

A Wilson-Snyder 2-outlet Switch Valve in operation at Continental Oil Company's, Ponca City, Oklahoma Refinery.

THE only valves combining all these features, Wilson-Snyder Switch Valves, are unequalled in coking operations where cracked tars, straight-run pitch, reduced crude, or other heavy stocks must move in a continuous stream. Designed for temperatures up to 1100°F. and pressures up to 600 P.S.I., the bodies and plugs are forged carbon or alloy steel with ground seating areas. Fluid pressure plus a thrust flange and adjusting nuts hold the plug in each valve tight against its seat. Reversing nut pressure on this flange quickly breaks the coke seal.

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Close-up view of a Wilson-Snyder Switch Valve ready for installation.

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PETROLEUM PROCESSING
FEBRUARY, 1950

New Pools Mostly Sweet Crude

Discoveries of 1949 Are Significant Not Only for Their Volume, But Also Because Low Sulfur Oil Being Produced Cuts Demand for Sour Crudes

By D. P. THORNTON, Jr.
Southwest Editor

THE importance to refiners of the host of new oil pools discovered in the southwest and elsewhere during 1949 and the year's extensions to older pools, lies not so much in the characteristics of the individual crudes involved as it does in the effect on the overall crude oil picture.

Much publicity has been given some of these discoveries, and a few perhaps have been over-glamorized. However, it should not be expected that these events will result in any radical change in general refinery operations or product yields in the near future. In fact, many new producing areas are so heavily prorated by conservation authorities their significance may not become apparent for some time.

One fact, however, is important to refiners over the country. Most of the 1949 crude discoveries have been low in sulfur and this, in turn, has already been reflected in a lessened demand for high-sulfur crudes. Not so long ago refiners were being told to prepare to process increasingly large quantities of the sour crudes. This need now is not so apparent. If this trend continues it will be significant to plant and equipment design engineers as well as the refiners themselves.

Not so many months back there was a scramble for crude connections by refiners, big, little and medium. All sorts of "premiums" were being offered and paid, producers were switching well connections from buyer to buyer, government "authorities" were dolefully predicting a crude scarcity and most any kind of crude —sour or sweet—had little difficulty finding a home. All this now is changed.

No longer is crude in a seller's market, and supplies once closely held now are being offered freely. It reportedly is not difficult now to line up several years' supply of sweet crude for a small Independent refinery without tying agreements. Not long ago a substantial quantity —several thousand barrels—of high gravity sweet crude sold for 15 or 20c below the postings. There have been "price adjustments" in a number of areas along with pipeline proration.

There are several reasons for this relatively abrupt transition from "scarcity" to "normal" in crude supplies. New pool discoveries within the U. S. and the prospects of continued successful exploratory efforts in presently undeveloped territory, as well as extensions to already proven areas have, for the time being at least, augmented existing domestic supplies. Importations of foreign crudes and discoveries like those in Western Canada have had the effect of increasing U. S. supplies. Of lesser importance have been relatively mild winters the past two years, greatly reducing the call for black oils and heavy crudes for processing into heavy fuel oils. Imports of residual fuel oil also have been increased.

There has been no great change in refinery operations based on the new production developments occurring in the Mid-Continent states of Kansas, Oklahoma and Texas and elsewhere in the U. S. Those plants located close to the new pools are getting larger fractions of the new crudes than those more distant which are supplied from a common pipeline stream. In this latter case the "new" production has been commingled with that from existing pools.

Consider, for instance, the effect of Scurry County, Texas, production. It is much in the limelight and its new discoveries are touted as potentially aggregating a billion barrels. The limits of this area are not yet known. North Snyder, the largest producer of the four new pools discovered in 1949, has a January net allowable of 16,200 b/d aaginst a total net for the county of 27,401 b/d. The other new pools have between them a net allowable of 5050 b/d net, while the three previously existing Scurry Co. pools may produce 6151 b/d total. All this new production dumped into the pipe lines draining the area roundabout has not materially increased the average gravity or refining characteristics of the common-stream crude delivered in Northern and Eastern areas, hence has not altered transportation costs either.

The development of large oil pools in Canada, plus the announced start of construction as soon as weather permits on the Interprovincial Pipe Line (from Leduc and Edmonton southeasterly through parts of North Dakota and Minnesota to end near Superior, Wis.) has backed up considerable quantities of U. S. crudes formerly exported and, when completed, will augment this effect. This line will be a common carrier in addition to serving Imperial's needs enroute.

The Canadian developments particularly have affected Rocky Mountain crudes, where pipe line curtailment effectively prorated production in

Crude Oil Developments

Map showing 1949 discovery wells and principal new pools in North and West Texas, and Oklahoma. Pools identifications are: Texas: 1, N. Snyder; 2, Diamond M; 3, Kelly; 4, reef extensioner in Kent Co.; 5, Sharon Ridge; 6, Dunn; 7, N. & S. Gail pools; 8, Good; 9, Borden; 10, Pegasus; 11, Campsey, and 12, Post Oak. Oklahoma: 13, Scholem Alechim; 14, Velma; 15, N. & S. Wayne; 16, Maysville & Antioch; 17, Lindsay & N. Lindsay; 18, Elk City; 19, Happy Valley; 20, Ringwood; 21, Rich Valley, and 22, S. E. Keys

those states. The volume of crude ultimately available in Canada and adjacent U. S. areas, will affect also oil production from Illinois and Indiana, as well as the Mid-Continent itself, since these crudes have been supplying refineries in the Great Lakes areas as well as eastward.

Mid-Continent Developments

Looking at the new pools discovered in the "Greater Mid-Continent" in 1949, and at pools discovered in 1948 whose significance became apparent last year, the Scurry County, Texas, development is probably the most important 1949 discovery in the eyes of production men. As this is written there are more than 200 completed wells and 160 to 170 rigs active there.

The Scurry play is extending into neighboring Borden and Kent Counties, where similar crudes have been discovered, lending logic to the expressed belief this may all be one crescent-shaped pool, 25 miles long and up to five miles wide, having pay formations up to 400 ft. thick. But —there *have* been some relatively unpublicized dry holes and bitter disappointments as history apparently repeats itself again. Fabulous prices are said to have been paid for leases, and the county seat, Snyder, is presently riding an oil boom of major proportions.

An idea of North and West Texas developments are shown on the ac-

companying map, which, however, does not list all the newly discovered pools.

Developments elsewhere in Texas are apt to be overshadowed by Scurry County, but new developments in Borden County nearby found 40 to 45 gravity sweet crude, on which current gross allowables total 3800 b/d, and in Kent County the possible Scurry extensioner wells have found production good for 500 to 600 b/d.

In Jack County, North Texas, two significant pools were brought in, producing 40 gravity or better sweet crude with a present gross allowable of 700 b/d; a third discovery, Worsham-Steed, is prorated to 2763 b/d.

Close to the New Mexico line in Upton County, the Pegasus pool, producing 52 gravity crude, has a 2000 b/d gross allowable.

Tidelands Still a Factor

Nor should the Gulf Tidelands bordering Texas and Louisiana be lost sight of. Developments here, however, have been seriously stymied by the war and more recently by the still unsettled political battles on whether the States or the Department of the Interior shall have leasing and regulatory power.

Another factor has been the element of great financial risk involved in off-shore prospecting, which has required development of specialized equipment, expensive transportation of men and equipment, and poses similar difficulties in getting discovered oil and gas to dry ground. Consequently many of the wells are shut in. The majority of 1949 discoveries were off the Louisiana coast. Sweet oil, gas and gas-condensate have been found, the crude ranging in gravity from 25 to 64° API, and discovery potentials (oil or condensate only) range from 7 to 932 b/d at individual wells.

One can only guess at this stage of development what time will tell about the Tidelands. The answer will not come until, first, political and legal arguments are settled. Then, more intensive development will come if and when oil demand and the income tax structure make it profitable.

77 New Pools in Oklahoma

In Oklahoma, 1949 saw some 77 new pools opened (compared to an estimated 119 in West Texas alone and 72 in Kansas) with 800 dusters and 4300 wells either drilled or started. Most of these were relatively small new pools and many wells were drilled as extensions or in the orderly development of existing production.

One of the most outstanding new Oklahoma pools is the Elk City area of Beckham County, which was discovered in December, 1948 with one well producing 17 b/d. It now has 13 which produced in excess of 5000 b/d in November, 1949, the last total available. The pool is approximately eight miles long and three miles wide at its greatest extent; is yet to be completely developed. The sweet crude ranges from 48 to 58 gravity and is gathered by Shell. Further exploration continues and Shell shortly will start work on a large natural gasoline plant in this area.

The so-called "Golden Trend" pools of McLain and Garvin counties saw their greatest development in 1949, efforts which brought the area into major prominence and saw the completion of the multimillion dollar Maysville natural gasoline plant of unique design (see p. 135 for description). There now are more than 360 wells in the five pools comprising this area, and under proration the November pipeline runs averaged about 34,000 b/d. Cities Service, Carter, Magnolia, Sinclair and Mid-Continent are the major buyers.

Other Oklahoma pools receiving major development or discovery in 1949, number of wells and latest actual production figures include: Ringwood pool, Major county, 19 wells, 1500 b/d; Rich Valley, Grant county, 6 wells, 600 b/d; S. E. Keys, Cimarron county, 1 well, 105 b/d; Happy Valley, Lincoln county, 23 wells, 730 b/d; Sholem Alechim, Stephens county, 145 wells, 14,200 b/d, and Velma, Stephens county, 265 wells, 22,500 b/d.

TABLE 1—Outstanding New Kansas Oil Pools, 1949

County and Pool	No. Wells	Pool Productivity b/d	Nov. Prodn.	Type Crude	API Grav.
Rooks, Berland	57	56,802	46,876	Sweet	36
Phillips, Huffstutter	12	792	5,390	Sweet	26
Wabaunsee, Davis Ranch	9	3,200	14,245	Sweet	28–29
	78	60,792	66,511		

Kansas Sees More Activity

Kansas drilled 17 more wells in 1949 than in 1948—3081 wells completed. Of this, there were 2606 wells drilled in developing existing pools (1440 oil, 412 gas and 754 dry) and 475 wildcats (64 oil, 10 gas and 401 dusters). On Jan. 1, 1950 there were 424 wells drilling in the state. As in Oklahoma and Texas, the majority of new pools discovered, which totaled 72, were sweet crude although most of them as yet are quite small in conformity with the general run of Kansas' oil production areas.

Half the new Kansas pools were discovered in four counties, with Barton leading the list with 11; Ellis, 9, and Butler and Stafford, 8 each, for a total of 36. The outstanding pools, however, were discovered in Rooks, Phillips and Wabaunsee counties, the particulars being tabulated above in Table 1. The productivity rating in the table is the maximum production in barrels per day assigned by the Kansas Corporation Commission after a draw-down test and may be considered a measure of the size of the pool.

Regarded as having potentialities for 1950 is the new Rhodes pool in Barber county, it was opened in 1949 with four small wells having a total productivity of 840 b/d. However, late in the year a fifth was brought in with a productivity of 9000 b/d, jumping the pool total to 9840 b/d of sweet crude.

Kansas' 1949 activities would not be complete without mention of the famous Hugoton gas field, which extends from the southwest corner of the state down through the Oklahoma Panhandle into Texas (see map). On the Kansas side 400 wells were completed in 1949, making 1847 wells connected to pipelines and given a total development of 1,167,344 acres and "proving" 2,225,000 acres.

Effects of Discoveries, Imports

Elsewhere across the nation it is apparent that major producing areas are bearing the brunt of the effects of freer crude as a result of new discoveries in the U. S. and imports. Texas, for instance, twice increased its production in 1949, but curtailed it in nine months and started 1950 with another reduction—admittedly to prevent waste. Kansas and Oklahoma did likewise, although not as greatly. Louisiana generally increased its allowables, even to disregarding curtailment requests from producers.

Pipe line curtailments were notable in Mississippi, Arkansas, New Mexico and the Rocky Mountain states. Illinois and Indiana ran almost as much oil as they could produce, due to demand from Independent refiners in Chicago, St. Louis, Indiana and Ohio. There was some production curtailment in Ohio as the demand from the East dropped off; similarly, Pennsylvania demand dropped in part because of the back-up of crude from the Mid-Continent and also reflecting crude imports. California demand remained comparatively steady and there were no major new discoveries, although development of previously discovered areas continued.

As 1950 opens, play in the principal discovered areas of Kansas, Oklahoma and Texas may be expected to continue without let-up and it is entirely possible that the reef play which has so excited oil men in Scurry County will be extended into New Mexico and even into Colorado as exploration of the flanks of that buried mountain range continues. Since the Canadian developments around Saskatchewan are similarly a reef, those in the "know" look for reef play to develop around Bismark, N. Dak., which saw active lease buying in 1949.

Reduce Oil Content of Refinery Effluent By Treating Emulsions Separately

By E. M. PROCTOR, Redfern & Laughlin, Toronto

To prevent contamination of lake waters from oil in refinery waste, the waste waters are segregated, the so-called clean waste being discharged through a conventional API type separator, while all emulsion-type wastes are handled in a special unit, the oil being separated by flotation, flocculation and settling. Oil recovered pays the operating costs of this part of the waste disposal system. This paper was presented at the Annual Meeting of the American Society of Mechanical Engineers, New York, Nov. 27-Dec. 2, under the title "Oil Refinery Waste Treatment".

SATISFACTORY treatment of industrial wastes requires the study of the individual components in the final discharge. To treat a mixture of wastes often is a very difficult problem. This is caused sometimes by a small flow of a certain waste which, when treated individually, makes it possible to get excellent overall results.

This is particularly true of refinery wastes which contain oil emulsions. In a standard oil separation tank where oil is floated off, the emulsions will pass through the tank. Analysis of the effluent will show a high oil content. The emulsions, when highly diluted in the receiving lake or river, break up, and the oil floats to the surface.

A method of handling emulsion wastes to correct such a condition is described. The results obtained show very conclusively that the emulsions, when passed through the main separation tanks without any treatment for breaking them down, have a decided effect on the oil content in the daily tests of the effluent. With the emulsion properly treated, the final tests show an even content of oil in the effluent, as seen graphically in Fig. 1. The upper curve shows the oil content in the effluent during August, 1945, before the emulsions were treated separately. The lower curve shows in the results during August, 1947, after the new unit had been installed for treating them separately. The average oil content had been reduced from 42 to 5 parts per million, and the irregularities in the content had been eliminated.

The refinery of the British American Oil Co., at Clarkson, Ont., was built during the war years and placed in operation in 1943. It has a capacity of 9,000 b/d and manufactures all grades of gasoline, lubricating oil, and asphalt. It is located on the north shore of Lake Ontario, about 18 miles west of Toronto.

The waters of Lake Ontario are, generally speaking, quite clear, and on either side of the plant are areas of high-class suburban homes. For these reasons it was necessary to provide high-grade treatment of any waste water discharge. The plant water supply is obtained directly from the lake and, except for the drinking water, is untreated. The temperature of the lake water is seldom above 60° F. and generally below 50° F. It is usually free from any excess turbidity. From every angle, the supply is ideal for refinery purposes.

The sanitary sewage from the different buildings is collected in a separate system and is passed through a large septic tank with field tile drainage bed. The industrial wastes and storm water are collected in a sewerage system of pipes and delivered to the separator and treatment plants as described hereafter.

All wastes which contain emulsions or high turbidities are collected in a separate pipeline and treated by chemical precipitation before discharging into the lake.

All other wastes are passed through an oil separator designed on the API standards. This separator has a primary and secondary basin with oil skimmers and is divided into two compartments. No scraper mechanism has been installed. It has been found that cleaning the bottoms of the tanks once a year is sufficient. The separator is about 165 ft. square. Discharge into the lake is about 1600 ft. from shore and in 25 ft. of water through a 48-in. steel pipe laid in the bed of the lake. The flow is diffused by means of an upward flow against a horizontal cover plate of concrete about 10 ft. square.

The novel feature of the waste disposal plant at the Clarkson refinery is the treatment of oil emulsions. This unit was added in 1945 after it was found that the emulsions were upsetting the operation of the main separator. The flow of 1,000,000 gallons per day of waste water charged with oil emulsions was segregated

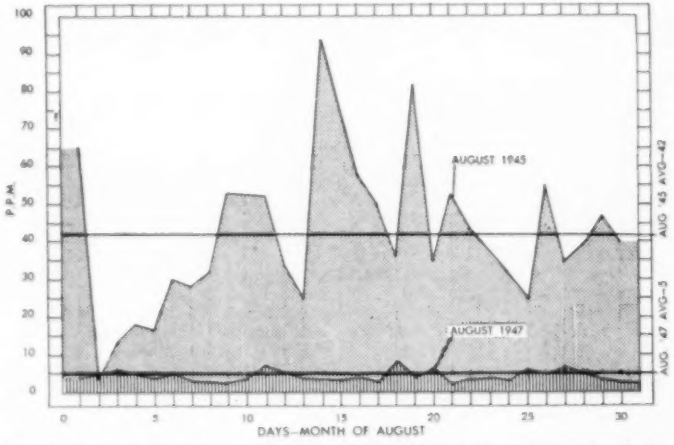


Fig. 1—Separate treating of emulsion waste reduced the oil content of the refinery effluent from an average 42 ppm., shown in upper curve, to 5 ppm., shown in lower curve

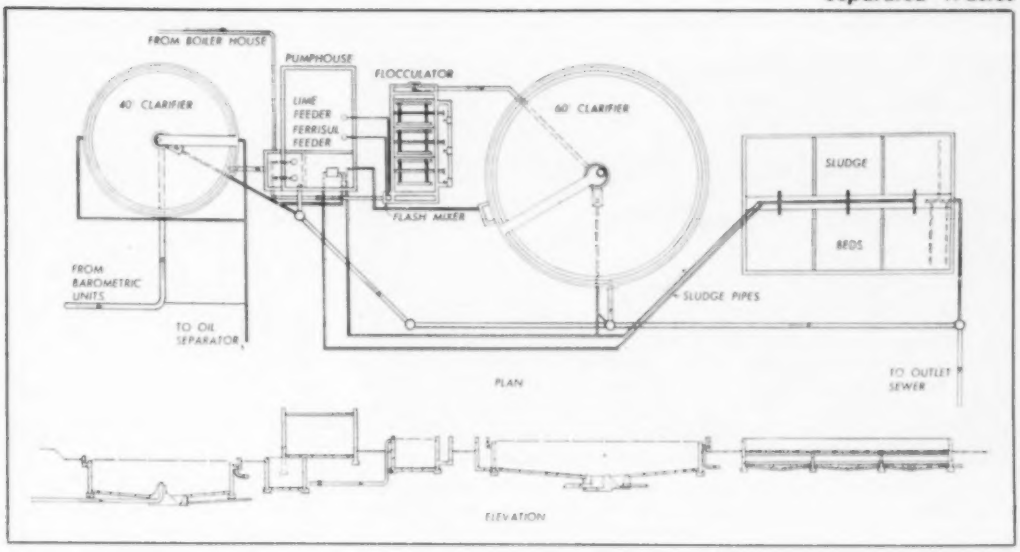


Fig. 2—Layout of waste disposal system for separate treatment of emulsion-type waste in British-American Oil Co.'s refinery on shores of Lake Ontario

from the other waste water and delivered to the plant specially designed for their treatment, the layout of which is shown in Fig. 2 and a photograph in Fig. 3. The plant consists of the following units:

1—Oil Flotation Tank, 40 ft. diam. by 9 ft. sidewall depth.

2—Pump House, for pumps, chemical storage and chemical dosing equipment.

3—Flash Mixer and Flocculation Tank, 12 x 28 x 9 ft. deep.

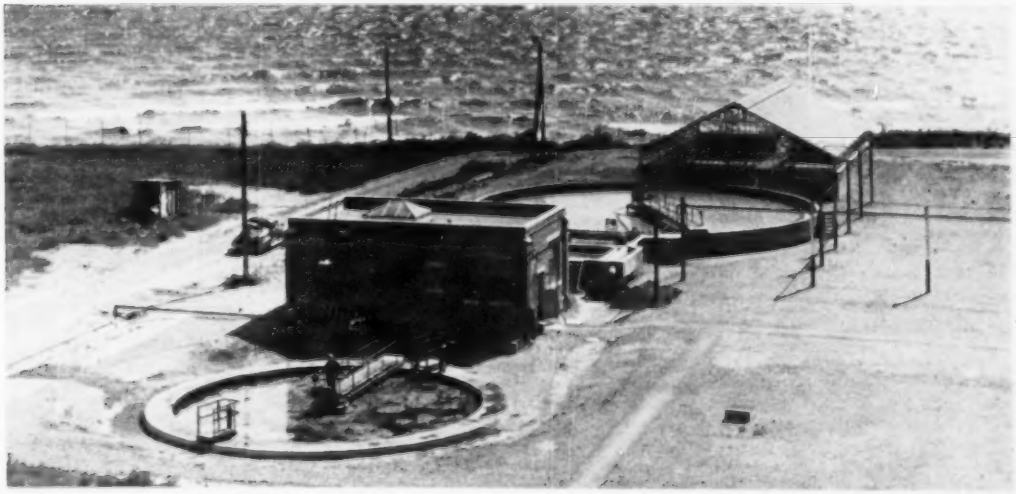
4—Settlement Tank, 60 ft. diam. by 8 ft. sidewall depth.

5—Glass-covered Sludge Drying Beds.

The oil flotation tank is 40 ft. diam., concrete, equipped with Dorr scraper mechanism for removing sludge. It is also equipped with two adjustable decanting funnels connected by Neoprene hose to the oil discharge line. As much as 200 bbls. of oil per day is decanted from this tank. This oil is clean and it is conveyed to a storage tank, from where it is put back into the manufacturing circuit. A 6-ft. deep, steel circular baffle plate extends around this tank about 8 in. from the overflow weir. The operation of this tank has been very satisfactory and very little visible oil is discharged from it.

The effluent from the flotation tank, which consists of waste water with oil emulsions, is delivered to a pump well where two vertical centrifugal pumps, float controlled, lift the water up to a flash mixing tank. In this flash mixer chemicals are added to create a floc. The oil content of the waste water is about 175 p.p.m. The chemical dosage is about 3 grains

Fig. 3—Compact emulsion treatment unit, looking south toward lakeshore



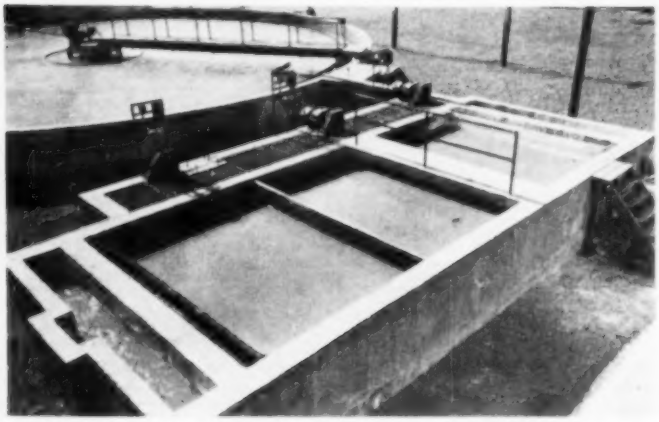


Fig. 4—Chemical treatment of the emulsion waste, in the rectangular tank, forms a floc carrying the oil, which then settles out in the round tank in the background

of hydrated lime and of "Ferrisul" per gallon. The latter is a commercial ferrous sulfate product. The flocculation tank is 12 x 28 ft. and contains three Dorr Co. paddle type mixers. In this tank a very heavy floc is created.

From the flocculation tank the flow is into a circular settling tank, 60 ft. in diam., equipped with Dorr scraper mechanism. In this tank the floc settles very rapidly and the effluent, which passes into the lake, is a clear sparkling liquid. The residual oil content is below 2 p.p.m. Fig. 4 shows the flocculation tank and the basin which the floc with the oil settles out.

The sludge pump, which is a Dorr Co. standard pump, lifts the sludge from the bottom of either the flotation or settling tank and discharges it into the sludge beds or into a tank truck, whichever is desired. The six sludge beds are composed of sand and gravel, with underdrains; these beds are laid on a concrete floor. It has been found that the beds are ample in size and that it takes about a week before the sludge is dry enough to spade. At present most of the sludge is being trucked directly to open air pits. The glass-cover provides means for handling the sludge during freezing weather, as the building is steam heated. (See Fig. 5)

In addition to the emulsion-charged waste from the vacuum towers, which is the bulk of the waste treated in this unit, there is also discharged into it the boiler and water softener discharges, the tank bottoms of the oil storage skimmed from the main separator and several other minor streams.

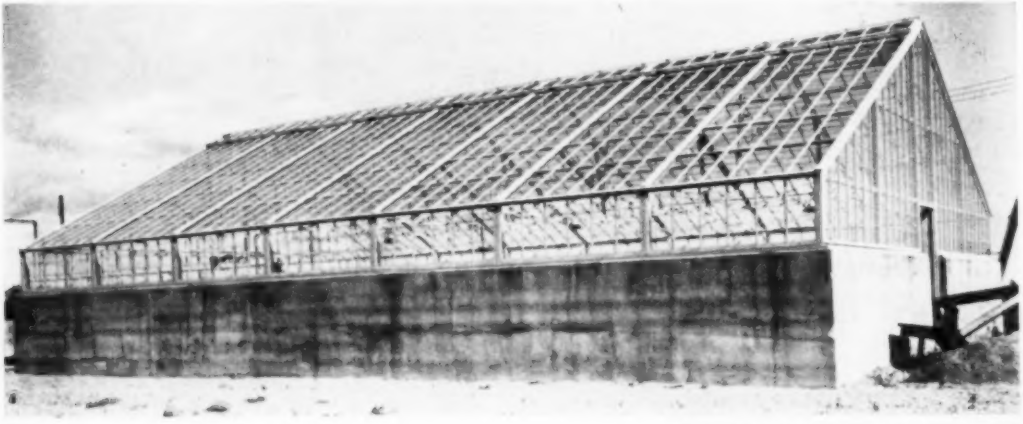
Before the construction of the unit and when all flows went through the main trap, it was difficult to keep the discharge of oil below 40-50 p.p.m. average in the effluent to the lake. Since putting the new plant into operation, the overall average discharge is about 5 p.p.m. With the diffusion which takes place, there is no trace of oil in the lake 50 ft. from the outlet. The one part of the operation which has not been completely solved is the disposal of the sludge from the final settling tank. A study is being made of incineration as a means for removing the oil from the sludge.

This type of plant lends itself very readily to treating a number of industrial wastes. By testing the action of various flocculating chemicals the proper combination can be obtained for the best treatment. Before adopting the design described, a series of tests were run and it was found that it required a heavy iron coagulant to overcome the floating effect of the oil entrained in the floc. Ordinary alumina sulfate formed a floc but it would not settle.

In the design of the settling tanks, the important thing to watch is the upward velocity in the tank. This must not exceed the downward velocity of the settling particles, otherwise there would be little complete settlement.

The successful operation of the primary flotation tank in removing free oil demonstrates the desirability of the circular tank over the conventional square-shaped tank. The tanks are easy to construct and provide a weir length many times greater than a square tank, since the weir goes all around the wall of the circular tank.

Fig. 5 — Above-ground construction used at Clarkson saved costly excavating into rocky subsurface, in many places almost immediately beneath grade. This glass covered settling tank permits efficient drying of sludge during cold and wet weather, typical of the area



New Plant Strips Wet Gas in Field For Central Handling of Rich Oil

By D. P. THORNTON, Jr.
Southwestern Editor

OVER 200,000 gallons daily of liquid hydrocarbons now are being recovered from gas collected over some 25,000 acres in Garvin and McLain counties, in south central Oklahoma, in a novel natural gasoline plant installation, part of a cooperative repressuring and conservation project in that area.

Two sub-plants collect the gas from pools close by, compress it and run it through absorbers. By means of an interconnecting pipe line system, the enriched absorption oil flows continuously to a central plant for distilling and processing into natural gasoline, butane and propane. The lean oil is recirculated to the field.

The stripped gas is dehydrated and used as fuel, sold to gas pipelines and a part of the gas is further compressed for injection into the underground reservoir. The three plants of the project have a combined design capacity of 80,500 Mcf. of gas daily, and will eventually recover 300,000 gallons of liquid products.

The companies cooperating in the so-called Carvin County Plants project are Carter Oil Co., Cities Service Oil Co., The Texas Co., J. E. Crosbie Inc., and Warren Petroleum Corp. Warren supervised construction and operates the installation. Dresser Engineering Co., Tulsa, were designers and constructors of the units. Only a few other natural gasoline plants in the country, as distinguished from cycle plant operations, have a greater liquid make than Maysville and not many have a larger throughput.

Operation Is Continuous

The principal new engineering feature of the installation is the arrangement for continuous operation, by flowing the enriched oil at absorber pressure from the Antioch and Lindsay remote sub-plants to the central Maysville processing plant. Eight-stage centrifugal pumps, among other services, pump the lean oil following stripping back to the absorbers at Antioch and Lindsay, as well as to the absorbers and demethanizers at the Maysville unit. The usual practice for a natural gasoline plant made up of decentralized units is to strip the absorber oil at the remote plant, and ship the "wild" gasoline by pipeline or tank car to central fractionating, storage and shipping facilities.

Approximately 520,000 gallons (65 tank cars) of mineral seal oil were required to fill the circulating system in the Garvin County installation, the absorbers of the three units, and for the heating-oil system and spare storage at Maysville.

Another engineering feature is that all process heat at the Maysville plant is supplied by four large capacity, direct gas fired, vertical-tube Petro-Chem heaters; the particularly unusual feature being that two of them handle a closed oil stream used for plant process heat instead of steam. (The other two heaters serve the two rich oil stills.) Also, in the interests of water conservation and here likewise, to reduce capital investment, radiator-type air coolers are used for heat exchange wherever process and application will permit and no steam is generated.

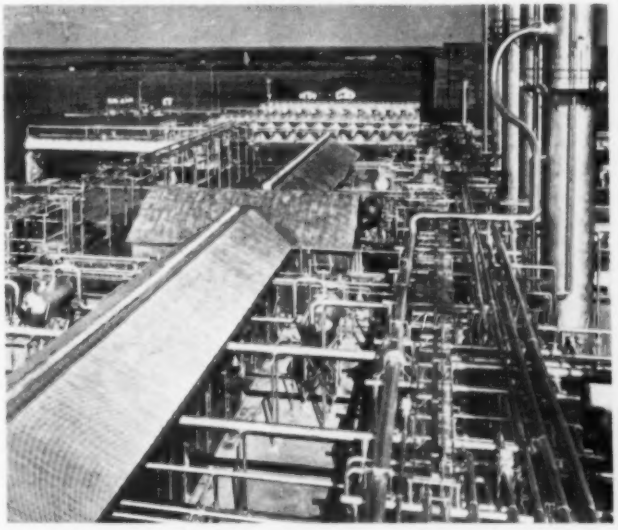
Approximately 280 miles of underground pipe lines, ranging from two to 30 in. in diameter, are required by the Garvin County Plants for gas gathering, gas injection, residue gas disposal and for oil, water, gasoline and liquefied petroleum gas.

A total of 21,200 compressor horsepower has been installed to handle the 80,600 Mcf. of gas processed daily, from atmospheric to 760 psig. absorber pressure, and an additional average of 25,000 Mcfd. of residue gas for reservoir repressuring at up to 2400 psig.

Approximately 8,655 gas-engine horsepower is required to drive electric generators, lean oil pumps, water system pumps and plant recompressors and propane refrigeration facilities.

Product storage facilities at the Maysville plant consist of 49 pres-

THIS MONTH'S COVER PICTURE



Part of the two lines of process units are shown in this view of the Maysville plant in Oklahoma. One of two identical stills is at the right, followed by the fractionating equipment. Cross-shaped roof in center protects process pumps at the two ends and the enclosed control room is in the middle. Part of the nearly two million gallons of pressure storage can be seen in the background, as well as one of the two cooling towers

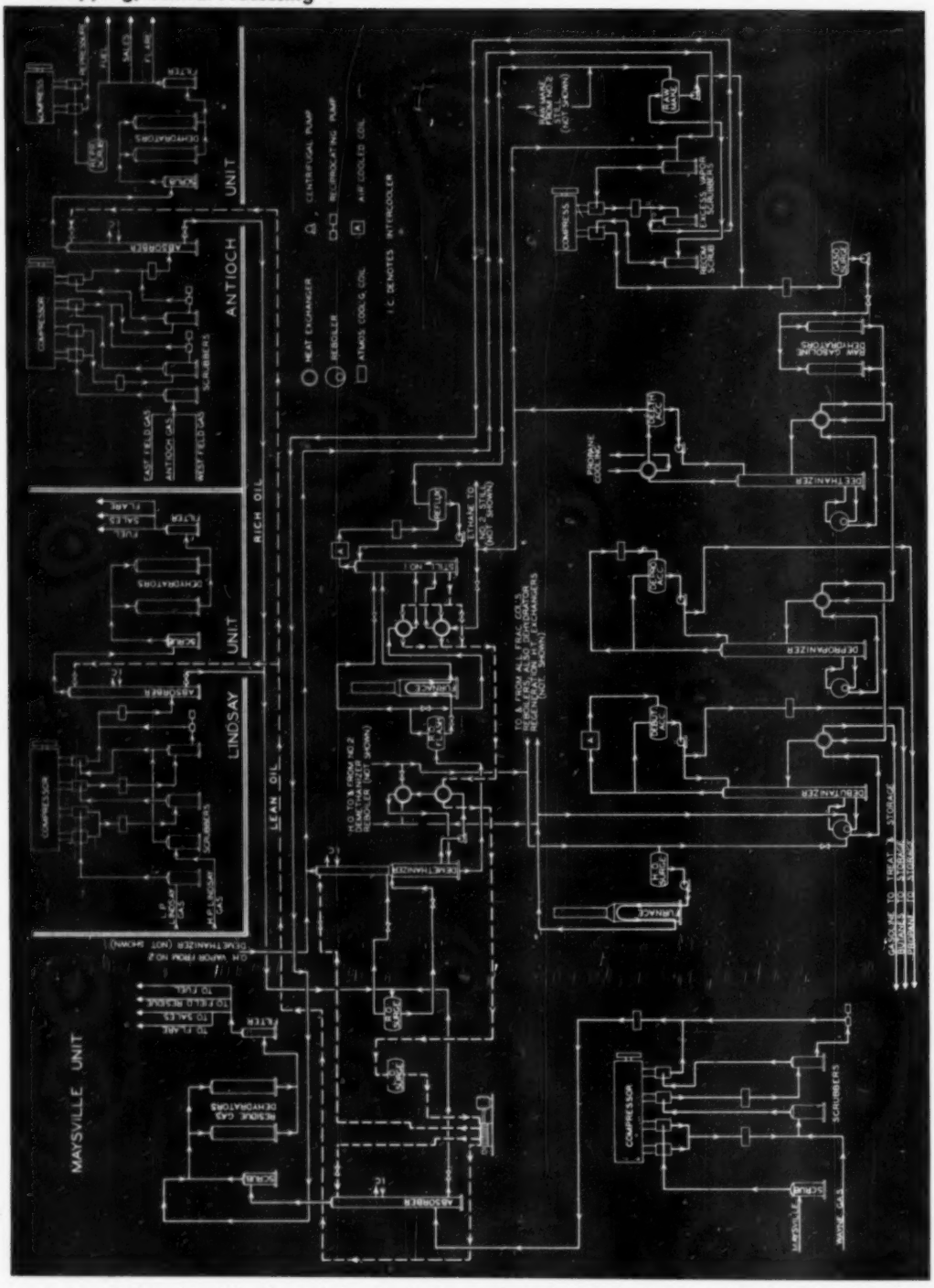


Fig. 1—Simplified combined flowsheet of the Garvin County plants, showing the Antioch and Lindsay absorption plants and the central Maysville distilling and fractioning units

sure vessels, with a total capacity of 1,907,000 gals. of which 629,000 is used for natural gasoline, 588,000 for propane and 690,000 gals. for butane.

Two "Slave" Units

The Antioch and Lindsay units each consist of a compressor battery, an absorber and gas dehydration facilities, plus engine-driven electric generating equipment and a cooling water tower. The Antioch unit has 13 gas-engine driven compressors totaling 8400 Hp. These compress field separator gas through three stages to 760 psi. absorber pressure, the design volume being 31,000 Mcf. per day. The absorber was designed for 800 psi. working pressure and 40,000 Mcfd. capacity. Gas for reservoir injection, up to 25,000 Mcfd., requires 2000 additional compressor horsepower and leaves the plant at 2400 psi.

Antioch was the first of the three units of the Garvin County installation to be completed. It was placed in operation in July, 1948, a year ahead of either the Lindsay or the "parent" Maysville units. Two used fractionating columns were installed for temporary service and the unit produced about 30,000 gals. per day of natural gasoline and butane until July, 1949, when distillation facilities at Maysville were completed and the temporary equipment removed. A flowsheet for this unit is shown as a part of Fig. 1.

The Lindsay unit, flowsheet for which also appears as a part of Fig. 1, was completed in March, 1949. It is equipped with 10 vertical gas engines of 800 hp. each and likewise delivers gas to the absorber at 760 psi. A total of 36,000 Mcfd. is the design figure and the absorber, like that at Antioch, will handle 40,000 Mcfd. Between March, 1949, and the completion of the Maysville unit fractionator system in July, Lindsay delivered raw compression gasoline, through pipelines now used for absorption oil, to the temporary stabilizer at Antioch previously mentioned. Maysville alone is able to operate independently, without additional equipment.

Maysville Absorption System

At Maysville, the front end of the plant with the exception of the absorber consists of identical twin units for demethanization and distillation. The design of the absorber unit is basically similar to those at Antioch and Lindsay, except that it handles the smallest amount of raw gas of any of the three. The absorber is 4.5 ft. in diameter, has 30 trays and is designed to handle 30,000 Mcfd. at 760 psi. At the present time 13,500 Mcfd. is being handled with a compressor installation requiring 2800 hp. This throughput will be increased soon, as additional wells are connected. The Maysville plant flowsheet is shown as the major portion of Fig. 1.

Gas enters the absorber at 760 psi. and 90° F. the lean oil circulation being approximately 155 gpm. At an operating rate of 13,500 Mcfd. of gas, absorber residue will amount to 11,000 Mcfd. The absorber residue gas, joined by excess vapor from the fractionating system (largely ethane) and the overhead from the rich oil demethanizers, is dehydrated in activated alumina dryers, filtered, and passes to the disposal system, where a part is used for plant and lease fuel and the balance sold to the Oklahoma Natural Gas Co. It is entirely possible for total residue gas to equal raw gas throughput, due to the contributions from the de-ethanizer and the two demethanizers, which process the combined hydrocarbons from all three units.

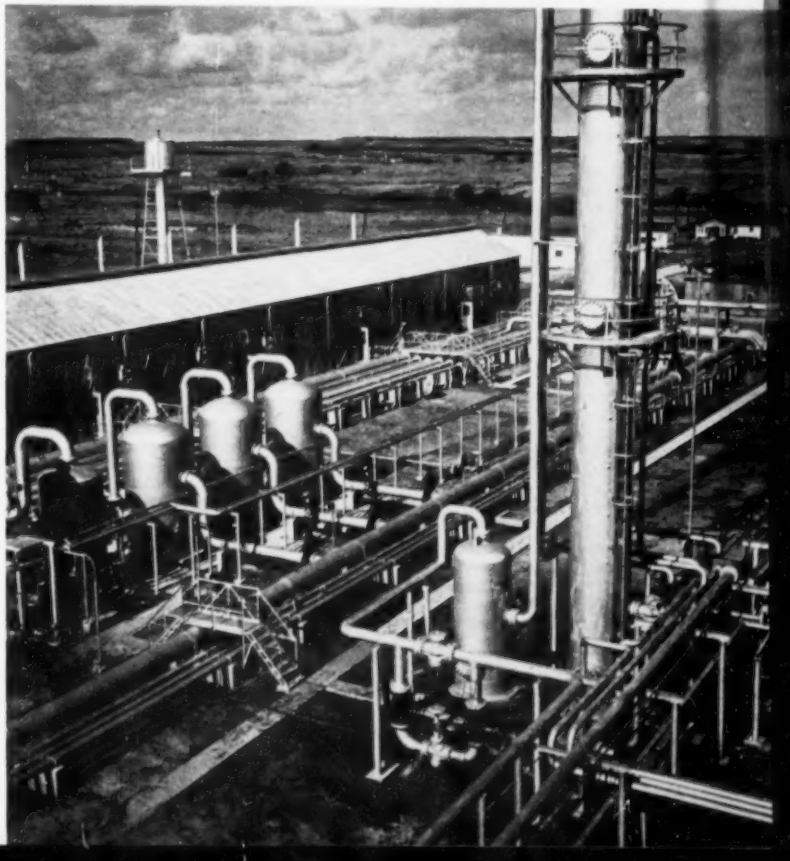
Rich oil from the absorber comingles with that coming from Antioch and Lindsay in twin rich oil surge tanks. Processing from this point on to the fractionation battery is split into approximately equal flows through identical equipment, the hydrocarbon streams joining again at the raw make tank.

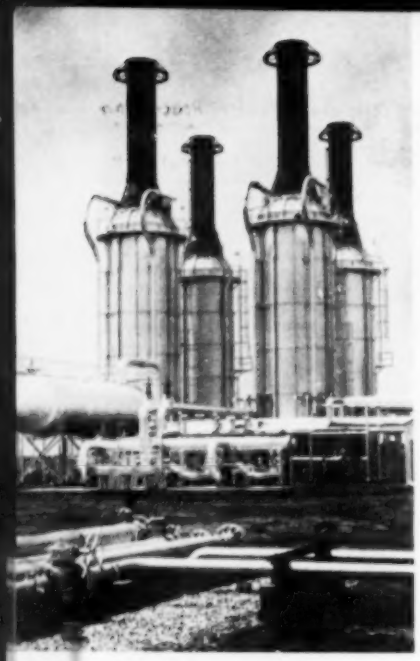
The distillation section is equipped with two each of rich oil demethanizers, rich oil heaters and stills. The reason for the paralleled units for this operation primarily was cost and to avoid excessively large vessel diameters. However, the arrangement also permits considerable processing flexibility. Since these units are identical, for convenience this section of the plant will be treated as though only single units were used and the flowsheet similarly indicates paralleled units exist but shows only one set for simplicity.

The 126-ft. demethanizer is 7 ft. in diameter in the bottom, or stripping section, which has 30 trays, and 4.5 ft. in diameter in the absorbing section, which has 20 trays; operating pressure is 250 psi. The 72 ft. still is 8 ft. in diameter, has 30 trays and operates at 110 psi. The heaters handle 680 gpm. each of rich oil at 130 psi., raising the temperature from 380 to 525° F.

The first stage flashing occurs in

General view of the Antioch "slave unit" of the Garvin County Plants. At left are the compressor house, compressor scrubbers and absorber at right. Absorber oil circulates over a 15-mile path to the "key unit" at Maysville





Four Petro-Chem heaters supply all process heat at Maysville. Similar, smaller single units heat regeneration gas for residue dehydrators at the two field sub-plants. Two of the heaters shown handle rich oil to the still; the other two handle hot oil used for process heat in exchangers and reboilers

the rich oil surge tanks, where pressure is reduced to 300 psi. and some 3000 Mcf. of vapors are released to the absorption sections of the rich oil demethanizers at this point. The rich oil enters the stripping sections of the demethanizers at 250 psi., with reboil heat being supplied by the general heating oil circulation system. Rich oil bottoms leave the demethanizer at 380° F., while the overhead residue gas leaves at 95° F. Lean oil is supplied to the demethanizer absorption section at 155 gpm. and 90° F.

Another interesting point in passing is that Acme recording gravitometers are used on the overhead streams from both rich oil demethanizers and the de-ethanizer. Although not involved in the automatic control circuits, these instruments are used as a quick check on the composition of these streams, and thus indirectly for control of the columns.

From the demethanizer, the rich oil is flashed again, this time at 130 psi., part of the vapors going directly to the still and the balance being exchanged against a portion of still bottoms before entering. The rich oil is heated to approximately 525° F. and enters the still slightly below the feed point for the unheated vapors. De-ethanizer overhead vapors, preheated to 495° F., enter below the bottom tray for stripping.

Still operation otherwise is conventional except that an air-cooled exchanger is utilized as the primary overhead condenser, an atmospheric section being used to obtain final cooling. Overhead vapor temperature leaving the still is 185° F., outlet from air cooler is 120° F., and, leaving the final condenser, 95° F.

The lean oil pumps are of interest because of the quantities and pressures handled and the fact that, compared with the facilities of a few years ago, each of the present single pumps is equivalent to three single-service pumps. Three identical units (one a stand-by) are installed, each being Pacific 8-stage bleeder type 600 gpm centrifugals, driven at 3750 rpm. by 500 hp. Cooper-Bessemer gas engines running at 450 rpm. through a Lufkin gear-type speed increaser. Suction pressure is 3 psi., taken on the twin lean oil surge tanks. Design of the pumps themselves now is considered conventional.

The second stage bleed discharges at 290 psi. to the rich oil demethanizer; the sixth stage to the Maysville absorber at 770 psi., and the eighth stage to the pipe lines serving the absorbers at Antioch and Lindsay at 1000 psi. Discharge temperatures are 150° F. on the eighth stage, 145° F. on the sixth and second stages; suction temperature is approximately 140° F. With single-duty pumps on the lean oil system, Maysville would have required a total of nine, including spares, and at a considerably greater capital investment.

Fractionation System

Streams from the two stills comingle in the raw make tank, maintained at 100 psi., vent vapors from this tank being recompressed to 200 psi. and discharged to the twin gasoline surge tanks, mixing with the liquid from raw make. Fractionation into propane, butanes and stabilized natural gasoline follows the familiar cascade system, in which the liquid is de-ethanized, depropanized and finally debutanized. However, before passing to the de-ethanizer, the entire liquid make is dehydrated in activated alumina dryers, which thereby permits refrigeration of de-ethanizer overhead with propane and eliminates further dehydration of the commercial propane after fractionation.

Debutanizer operating conditions are determined by the vapor pressure of the natural gasoline grade being made, the usual product not exceeding requirements for NGAA Grade 26-70. An unusual feature here, incidentally, is the use of an air-cooled exchanger for total condensation of the overhead product, in which the butane vapors have a temperature of 180° F. and leave the cooler at 120° F. A reflux temperature of 140° F. is obtained by bypassing some of the overhead vapors into the accumulator. Final product cooling to 90° F. is obtained with atmospheric sections.

Plant Utilities

A mineral seal oil similar to that used as absorption oil takes the place of steam in this plant for all process heating, including regeneration gas for the alumina dryers. Two Petro-Chem direct-fired, vertical tube coil heaters rated at 41,500,000 Btu. each handle 1400 gpm. of oil at an outlet temperature of 500° F. to supply the stills, all fractionator reboilers and space heaters within the plant. They are gas-fired and controlled from a small control room, separate from that for the plant. Small Petro-Chem heaters at Antioch and Lindsay heat regeneration gas for the alumina gas dryers there.

While a considerable sum has been expended in the three units of the Garvin County plants to minimize the use of water, approximately 400,000 gal. per day of makeup are required to meet the cooling needs not handled by air cooled exchangers. Design cooling water circulation capacity is 22,800 gpm. Even though the Washita River runs between the Lindsay and Maysville units, plant water comes from four 500-ft. wells drilled in a radius of a mile from each other and 17 miles from Maysville.

Surveys had quickly shown that there was not enough nearby water in dependable quantity to supply the units. It also was conclusively proven that the flow rate of the Washita would be insufficient in summertime to supply peak demands without construction of a sizeable reservoir: heavy chemical treatment also would be required. Therefore, the cost of drilling wells so far away was at the least a standoff. The wells now supply 10,000 b/d total to the three units.

Cooling water at Maysville in the amount of 12,000 gpm. is circulated over two Fluor induced-draft towers rated to reduce water temperature by 15° to 85° F. Similar towers at Antioch and Lindsay circulate a total of 10,800 gpm. more. Engine-jacket water at Maysville is handled in a closed system by four Happy air-cooled units of 1800 gpm. capacity each, taking water at 140° F. and cooling it 10°, with similar coolers at Antioch and Lindsay.

The tank car loading racks are located close to the town of Maysville, and approximately two miles from the Maysville plant. They consist of a 36-spot rack with electrically-driven Gould centrifugal pumps, located in the Maysville unit, capable of delivering 400 gpm. of propane at 288 psi.; 400 gpm. of butane at 200 psi., and 400 gpm. of gasoline at 160 psi. A four-spot tank truck loading rack is located outside the fence adjacent to the Maysville unit.

Viscosity Index Improvers Are Found To Give Good Consumption Properties

By WILLIAM F. BLAND
Engineering Editor

DETROIT—Viscosity index improvers not only are helpful in giving a crankcase oil good low-temperature starting characteristics, but also do not detract from the oil's consumption characteristics, according to studies reported at the annual meeting of the Society of Automotive Engineers here Jan. 9-13.

The investigations of V.I. improver additives were carried out by engineers with Standard Oil Development Co., and were aimed at answering questions which have been raised concerning the effects of such additives on an oil's cold starting and consumption properties under actual service conditions.

In other papers presented at the meeting, the more than 5000 petroleum and automotive technologists in attendance learned that:

1) Precombustion reactions in the cylinder of a spark ignition engine may cause extensive changes in the fuel structure, so that the fuel actually ignited is significantly different from that fed to the carburetor.

2) A 30% gain in the efficiency of automobile engines can be had whenever higher octane fuels required for their operation can be provided in a commercially practicable manner.

Viscosity Index Improvers

High viscosity index oils have long been recognized as offering the readiest means of meeting the two crankcase oil properties most apparent to the average motorist—ease of low temperature starting, and low oil consumption. And viscosity index improver additives have made it possible to produce oils with V.I. levels well above those practicable by even the most efficient refining methods.

Since the introduction of such additives in the middle 1930's, however, doubts have been expressed in some quarters as to whether the performance characteristics anticipated from the viscosity and V. I. properties imparted to an oil blend by the additive are actually realized under service conditions.

The results of studies made during the past years on the performance of high V.I. oils were reported to the SAE meeting in a paper "Performance of High V.I. Motor Oils" by C. L. Fleming, Jr., B. W. Geddes, N. V. Hakala and C. A. Weisel, all in the Elizabeth, N. J., laboratories of Standard Oil Development Co.

In one series of cold room tests reported, it was found that oils with similar low temperature viscosities had similar starting characteristics, regardless of whether or not a V.I. improver additive had been used to achieve the low temperature viscosity.

A number of laboratory and road tests were also carried out to determine, under actual engine operating conditions, the oil consumption characteristics of high V.I. motor oils compounded with V. I. improving additives as contrasted to straight mineral oils.

In each case the oil with V.I. improver added exhibited consumption characteristics at least equal to those of straight mineral oil of the same high temperature viscosity.

In general, the authors concluded that:

(a) Low temperature starting properties of high V.I. oils containing certain V.I. improvers are identical to those of straight mineral oils having the same viscosity at the low temperatures.

(b) Oil consumption properties of high V.I. oils containing V.I. improvers are identical to those of straight mineral oils having the same viscosity at 300° F.

The authors also reported on studies made of the viscosity stability of high V.I. oils, and concluded that the apparent viscosity change occurring in the oil they studied was not great enough to have any significant effect on the performance of this oil, particularly with regard to oil consumption.

Precombustion Reaction

The new data on what happens to fuels immediately prior to ignition was contained in a paper "Precombustion Reaction in the Spark Ignition" by Edmond R. Retailliau, Harold A. Ricards, Jr., and Minor C. K. Jones, all with the Esso Laboratories of Standard Oil Development Co.

Several years ago, the authors reported, it was discovered that the sulfur compounds and TEL in ordinary motor gasolines were oxidized to a large extent during the compression stroke of an engine before spark ignition of the mixture occurred. It was discovered also that the gasoline itself had undergone changes during the compression prior to the point where spark ignition would normally occur.

Therefore, additional experiments were performed with pure sulfur-free hydrocarbons of various types which were normal gasoline components. The experiments indicated that it was a normal engine occurrence for the air-fuel mixture to prereact to some extent on compression before ignition. These oxidation type reactions have been termed "prereactions" to differentiate them from reactions occurring in the unburnt part of the charge ahead of the advancing flame

Annual Index Now Available

Copies of the annual index for PETROLEUM PROCESSING are now available, covering Vol. 4, January through December, 1949. The index includes separate subject and author listings for all material published in the magazine last year. Copies may be obtained by requesting No. 25 on this month's reply card (see What's New section), or by writing directly to the editor:

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A limited number of copies of previous annual indices are also available, and may be had as long as the supply lasts upon request to the editor.

Mrs. Harry L. Horning presented the 1948 Horning Memorial Award to T. A. Boyd, General Motors Research Laboratories consultant, Jan. 11, during the 1950 annual SAE meeting for his paper "Pathfinding in Fuels and Engines." At right is Albert J. Blackwood, assistant director, Standard Oil Development Co., chairman of the award committee

front after spark ignition has occurred.

The prereactions, it was learned, are initiated by compression heat. Once the reactions are initiated, chemical heat is usually evolved and further reactions occur, probably by chain reaction mechanism. It has been observed that cracking, dehydrogenation, polymerization, and formation of various types of oxygenated compounds occur during prereactions, even when a single hydrocarbon is used as fuel. Even more complex mixtures are to be expected when gasoline is fed to an engine.

The results of the work, according to the report, "would indicate that the prereactions of the fuel which occur prior to its combustion . . . can significantly effect the nature of the combustion, and hence the performance of the fuel in an operating engine."

On the subject of knock and prereaction, the authors concluded that "the occurrence of prereactions appears to be closely associated with the occurrence of knock. Contrary to the prevailing theories of knocking, it appears that, in many cases, knocking may in part be due to the fact that at time of ignition the fuel mixture consists not only of hydrocarbons but of a complex mixture resulting from oxidation, dehydrogenation, cracking and polymerization of both the original hydrocarbons fed to an engine and of intermediate reaction products."

One of the most important variables affecting prereaction, the authors pointed out, is the temperature prevailing in the engine cylinder at the beginning of the compression stroke. This temperature is dependent upon the temperatures of the intake air-fuel mixture, jacket, piston top, cylinder wall, and the residual gases present from the previous cycle. The extent of the prereactions increases rapidly with increase in the intake temperature.

Fuel composition is also in important variable. Aromatic fuels, it was learned, are relatively stable during compression and resist prereaction; paraffinic fuels undergo prereactions, iso-octane being more resistant than its blend in n-heptane. In paraffinic fuels, TEL minimizes or in stable aromatic fuels the TEL is oxidized before noticeable prereaccontrols the extent of prereactions; tions occur.

Horning Memorial Award

The prediction as to future increase in the operating efficiency of automotive engines was contained in the Horning Memorial Lecture "Pathfinding in Fuels and Engines" by T. A. Boyd, General Motors Research Laboratories consultant.

Mr. Boyd was awarded the 1948 Horning Memorial Medal by the SAE for his paper, selected as the "best paper on the adaptation of fuels to internal combustion engines." The award was established in memory of the late Harry L. Horning, a past president of the society.

In his paper, Mr. Boyd, who collaborated with Charles F. Kettering and the late Thomas Midgley, Jr., in discovery of tetraethyl lead, presented a comprehensive review of research carried out over the last 30 years on the adaptation of fuels and engines to each other, and urged that research be continued for still more efficient fuels and engines.

"The incentive for further research on fuels and engines," he said, "is far greater than merely the advancing of knowledge of the subject. It rests on the base of the huge economic gains realized out of the investigations conducted thus far, and on similar benefits still in prospect.

"Just since 1930 the efficiency of the average automobile engine, measured in ton miles per gallon (of gasoline), has been boosted by 30% or more. On the huge gasoline bill of the nation today, that improvement represents a yearly saving to the public of more than $2-billion. . . .

"Furthermore, as has been shown in the recent research on still higher compression automobile engines, there is at least another 30% gain in economy to be had, whenever the fuels required for it can be provided in a commercially practicable manner."

Still Know Very Little

Even with today's huge backlog of technical data on the subject, Mr. Boyd declared, much remains to be learned.

". . . It must be recognized that all these investigations of fuels and how they burn in engines, although fairly extensive in scope, have not yet yielded a thorough understanding of the subject," he said.

"They have produced no explanation of why the structure of a hydrocarbon influences the way it burns in respect to knocking behavior, or why an antiknock agent exerts the remarkable effect it does, nor of many other factors.

"Fact is that we are still a long, long way from having attained a complete understanding of what happens when fuel burns in gasoline engines," he added.

A graduate from Ohio State University in 1918 in chemical engineering, Mr. Boyd joined Mr. Kettering's research group shortly thereafter. He received the professional degree of chemical engineer in 1938, and his alma mater awarded him the Lamme Medal for meritorious achievement in engineering in 1939.

The SAE committee which selected Mr. Boyd to receive the 1948 Horning Memorial Medal is composed of Chairman Albert J. Blackwood, assistant director, Standard Oil Development Co.; A. M. Rothrock, assistant director of aeronautical research, National Advisory Committee for Aeronautics; and Grover C. Wilson, research coordinator, Ethyl Corp.

Refinery Reduces Maintenance Costs With Efficient Equipment, Practices

Texaco Reduces Costs and Man-hour Losses by Using Portable Storehouses, Regularly Scheduled Delivery Service on Tools And Supplies, and a Simplified Perpetual Inventory System

By WILLIAM C. UHL, Equipment Editor

TOP efficiency in maintenance plays a major role in the improvement of overall plant operations at the Lockport (Ill.) Works of The Texas Co. Among time-saving techniques and equipment adopted recently or under study and development for future use at the plant are:

1—A portable general storehouse and toolroom which is moved from area to area as each unit turnaround or other major repair job appears on the planning schedule.

2—A portable storehouse especially designed for insulation work.

3—A regularly scheduled tool and supply delivery service, using telephone orders, and estimated to cut out about half the "miscellaneous" trips back to the central storehouse by maintenance personnel.

4—A simplified perpetual inventory system for warehouse items, tools, parts, etc., involving greater use of office accounting machine and featuring use of a wire-recorder.

5—Anticipated use of another especially designed trailer to serve as a portable office for maintenance supervisors.

A satisfactory and economical method of handling tools and materials during inspections and on other large repair jobs has always been a major problem of refinery management. Most plants have tried many different methods with varying degrees of success to reduce the loss in productive man-hours consumed, for example, by workmen traveling on foot to and from the job and the storehouse and tool rooms for hand tools and small parts such as pipe fittings, bolts, valves, gaskets, and the like.

Converted Semi-Trailer

At Lockport this problem has been solved most satisfactorily by a portable storehouse and tool room. This piece of equipment is a low slung, van type, trailer unit converted from a reconditioned automobile transport semi-trailer by installation of a permanent front wheel mounting and addition of new side walls and a roof. Tandem rear wheels are used, permitting the use of practically a full width floor.

Overall dimensions of the mobile storehouse are about 35 ft. long, 7 ft. 10 in. wide, and 10 ft. high from the ground level. Road clearance is 1 ft. 2 in. There are two rear doors totalling 6 ft. in width and 6½ ft. high. A wide door for dispensing materials is on the right side near the center, and is made in two sections totalling 6 ft. 2½ in. high by 2½ ft. wide. The side walls and roof are insulated with ½-in. Celotex. A king pin receptacle and draw bar for coupling to a power unit (plant tractor) is located at the front end of the trailer.

Mounted on a small bracketed table at the front of the trailer is a "Ridgid Porta-Power" portable pipe cutting and threading machine, for pipe in

Mobile storehouse and toolroom used at Lockport, showing rack for large gaskets at the left, dispensing window at center, and small pipe machine at right

Left: interior of the mobile storehouse, looking toward the front end. Right interior view showing telephone in dispensing window, public address system microphone, and part of the McCaskey tool control system panel boards

sizes through 2 in. A stock of miscellaneous lengths of pipe in sizes through 2 in. is kept on a rack on the underside of the trailer. This permits repairmen to obtain what they need, cut it, thread it, and be on their way quickly, with no waiting.

A removable shelf is located on the outside wall just to the left of the dispensing window for the convenience of workmen in making out tool tickets, repair lists, time sheets, etc.

Exchanger gaskets are stored on a large rack mounted on 4-in. casters, which is also part of the trailer's standard equipment. When not in active use, this rack can be rolled inside the trailer.

Shelving Is Flexible

The floor space of approximately 260 sq. ft. has been utilized effectively by a number of units of Berger "Wedge-Lock" steel shelving, 7 ft. high by 18 in. deep. This type was adopted because of its flexibility in that spacing between shelves and bin dividers may be altered quickly to meet changing stock conditions or material sizes. Approximately 550 bins have been provided by this shelving, in sizes ranging from 2 x 4 x 4 in. to 36 x 36 x 18 in. Additional storage is provided in the front recess of the trailer by two "Rota-Bins" and special gasket racks.

Equipment such as electric cords, impact tools, air grinders, and other heavier items are stored on a specially designed rack built of tubing at the rear end of the trailer.

Power is furnished by a plug-in attachment which fits the plant's regular 440-volt welding machine outlets in all areas. A transformer in the trailer provides 110-volt current for lighting, ventilating, and power tools.

The interior illumination is furnished by eight, 96-in., fluorescent light fixtures installed lengthwise along the ceiling. Six ¾-in. Crouse-Hinds vapor-type industrial lighting conduits mounted three on each outside wall furnish adequate lighting for the immediate area around the trailer during night shifts. Heating and ventilation is provided by a 7.5 KW "Electromode" electric unit heater with fan. These features along with rubber floor mats contribute to the efficiency and welfare of the trailer attendants.

A telephone connection to the plant system keeps the portable storehouse and tool room in constant contact with any point in the refinery. A public address system serves to page supervisors, individual craftsmen, or operators, and also advises particular workers of the receipt of their materials when delivered from the central storehouse or shops.

Specific Stock for Each Job

The trailer always carries a standard complement of general tools and storehouse stock, but prior to moving to a particular operating unit all special tools, gaskets, and other items peculiar to that unit are loaded. Bins are labelled with the descriptions and also a maximum quantity is indicated on the label as a means of controlling the inventories and also the weight on the trailer. In addition to the regular stock, all other items ordered for the unit being served are delivered to the trailer and dispensed by the attendants.

A special accounting procedure for the disbursing of trailer stocks eliminates the necessity of a foreman preparing charge slips for each individual disbursement. Charges are handled on a beginning and ending inventory basis for the particular process unit to which the trailer has been assigned. This feature saves considerable time for the worker. Formerly he had to find his foreman and obtain a signed storehouse ticket for his material requirements.

All tools are controlled through the use of the regular plant tool system, using McCaskey tool check boards. As a workman secures a tool, his original tool charge slip is placed on the check board under a clip on which his clock number is shown. When he returns the tool, the slip is removed from the clip and returned to him for destruction.

One Tool Dispenser

One counterman is assigned to the duties of dispensing both tools and materials. He works full time, with additional help during the peak periods at beginning and ending of each shift.

There are at least six obvious advantages in the use of this trailer. The Texas Co. believes.

1—Time saved in locating tools and materials.

2—Reduced time lost in delivery of materials.

3—Reduced quantity of lost and misplaced tools.

4—Reduced quantity of storehouse stock left after a job is completed, and usually damaged by weather and mis-handling.

5—Maximum efficiency in the use of tools.

6—A central point, or nerve center, for communication, tools, and material.

As an indication of the services performed by the trailer, during a recent test and inspection period on the Fluid catalytic cracking unit at Lockport, some 34 days, a total of 24,420 items of material and 7,060 items of tools were dispensed from

it. The cost of the trailer, completely equipped, and ready for srevice was about $8,300. Company engineers estimate it paid for itself on the first major turnaround of this unit it served.

Insulation Trailer

Another portable unit in use at Lockport has reduced expenses in handling and storing, on the job site, insulation, insulating cements, galvanized sheet iron, felt paper, tie wire, etc. It is low slung, van-type semi-trailer, 32 ft. long, with the interior arranged to handle this type of material.

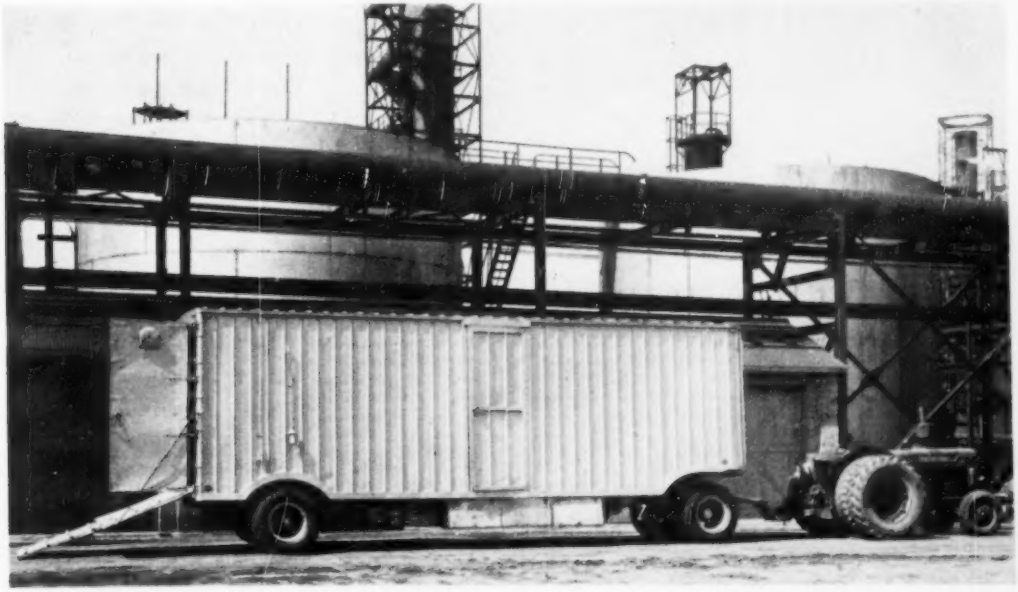
Wooden bins along one side accommodate a stock of approximately 25 items of pipe and block insulation, and other miscellaneous materials. A folding workbench in the rear of the trailer provides working space for insulators to handle layout and cutting. It is planned to install a small electric band saw at this point. Electric lights and power are furnished, but there are no facilities for heating or cooling because no attendant is on duty regularly.

During a test and inspection period on a unit, this trailer is set up close at hand, and furnishes immediate stock of materials for all minor repairs and enough materials to start a major project, pending the receipt of additional supplies from the central storehouse. Materials are fully protected from the elements at all times without the cost of erecting and dismantling temporary shelters at each job.

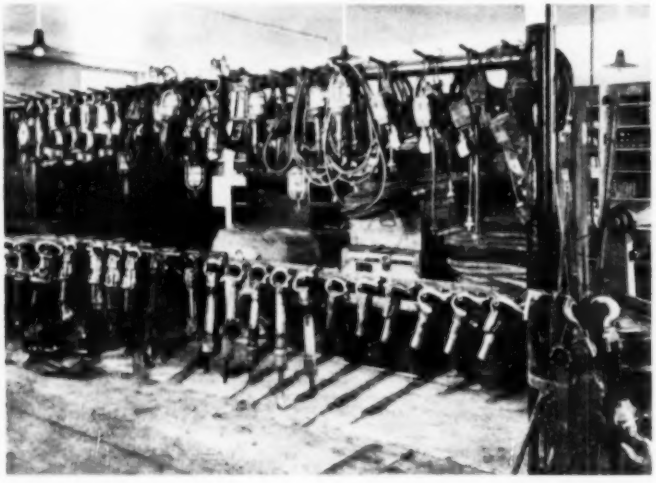
The tail-gate has an extendable section so that it may be used as a ramp for conveying materials to and from the trailer. Facilities are also provided for carrying all insulating tools in boxes mounted under the trailer frame.

A system for the delivery of tools and materials from the various plant storehouses to points throughout the refinery on telephone requests from field forces was established on an experimental basis in 1947, and set up permanently in March, 1949. It provides for the delivery of any item to certain specific delivery points on receipt of a phone order from any

Interior view of the portable insulation trailer



Texaco's mobile trailer for insulation work



Above: portion of the refinery's central toolroom, showing McCaskey panels at the left, on the dispensing counter. Below: efficient storage for heavy power tools, extension lights, etc., is provided in the central toolroom

supervisor, top operator, or No. 1 craftsman.

A full-time order clerk is stationed in the central storehouse and receives all telephone orders. He prepares an especially designed storehouse charge slip direct from the phoned request, indicating the material required, the person phoning in the order, his department, a general description of the job on which the material will be used, and the specific numbered delivery location to which the order should be sent.

This slip is then passed to the counterman for filling. The duplicate of the slip, designed as a combination "truck order" and memorandum to the field forces, is passed to the truck driver who will deliver the material.

Two trucks, a ¾-ton pickup, and a 3-ton stake body equipped with a hydraulic tail gate and a power winch, are assigned full time to the Storehouse Department to handle deliveries. A ½-ton pickup is also used for about four hours each day in this service.

Trucks Follow Definite Route

Deliveries are handled on a scheduled route basis. Trucks leave the warehouses at specific intervals during the day, thereby insuring the delivery of all orders within a predetermined time.

To further insure the delivery of orders to the proper location, storehouse delivery numbers have been assigned to all delivery points. This eliminates lost time and confusion caused by misplaced material or tools when deliveries are left to the discretion of the truck driver.

This system has eliminated approximately 50% of all trips on foot to the storehouse by craftsmen or their helpers, and the company expects that percentage will gradually increase as the system is perfected.

Tool Control System

The primary purpose of any tool control system is to provide sufficient information as to what tools are on hand and where they are at all times, in order to make certain that sufficient tools are available when and where they are needed. An adequate system must furnish this data with a minimum amount of clerical effort and delay at the dispensing window.

The Texas Company adopted the McCaskey system in April, 1948, after considerable investigation of a number of different methods in use at various refineries. The basis of this procedure is a carbon-backed tool order slip, made out by the individual employe as he requires tools. These slips are presented at the dispensing window—either at central toolroom or the mobile unit—where the attendant fills the order.

The original and one copy of the slip is inserted under a spring clip on a panel board on which are posted the payroll numbers of all employes authorized to withdraw tools. The third copy is kept by the workman. It serves as a means for keeping him currently informed of the tools charged against him and of his responsibility for their return.

Second Copy Kept for Record

When tools are returned, the employe receives the original of his order form which he destroys along with his copy, thereby cancelling his obligation for the loan of the tool. The remaining copy is retained for inventory, rate of turnover, or any other informative purposes. For example, the date and time is electrically stamped on each slip as the employe receives or returns the tools. This is an invaluable aid in keeping proper inventory records when a count is being made while certain items are out in the field. An interesting sidelight is that the time also indicates whether any individuals may be quitting work before the end of their shift.

The feature of having the employe sign for his tools rather than using brass checks or records made out by the attendants is believed very desirable in that it gives the employe a definite feeling of responsibility. In most cases he has been given an in-

centive to make every effort to return the equipment in good order.

Since the installation of this procedure, tool loss has been reduced to a rarity. Prompt return of tools has also made it possible to have a full supply available for distribution at all times with a minimum inventory, thus reducing the need for too frequent purchase of new tools.

Revised Inventory System

A revamped inventory procedure incorporating greatest possible utilization of accounting machines and a general simplification of records has resulted in increased speed and accuracy and the complete elimination of one clerk at the Lockport refinery.

A careful study of existing methods revealed that approximately 50% of the total storehouse issues and invoice paper work was being used to cover only 5-6% of the total stock of items purchased and disbursed, based on dollar value. This 5-6% constituted the many small, fast-moving materials from the plant storehouses, such as nails, small bolts, flashlight batteries, screws, and the like. Although high in volume, these items were low on the cost scale. It was therefore difficult to justify the large amount of paper work which caused the use of 50% of the time.

First step in improving efficiency was to eliminate the separate accounting for each type of material, lumping together all such items under one account, listed as "Small Stores".

Changed to Perpetual Method

Inventory-taking itself, which has been done on a conventional once-a-year basis, was changed to the perpetual method. This requires the services of two full-time tally clerks on a year-round basis. Daily movements of all items are recorded in a revolving type card file, the "Cardineer". These records are adjusted every 30 days by an actual count. The 30-day period is staggered, with a certain segment of the total stock being covered by a physical count each working day.

A wire-recording machine is now under investigation for possible routine use in taking inventory. Plant officials are thoroughly satisfied with the results of an experimental inventory on the portable storehouse and tool room. This was done as usual, before and after a turnaround job to which the trailer has been assigned. The procedure was as follows:

One man took the wire recorder to the trailer and made a physical count. He spoke into the microphone, reporting the description of the item and the quantity, pausing for about 10 seconds between each item while allowing the machine to continue running.

Fill in Price Information

Then the wire recorder was taken to the storehouse accounting department and a clerk played it back, checking the physical counts against the records, making adjustments as required. As each blank space came along on the wire (the 10 second pause), this clerk inserted price information about the preceding item.

The recording machine then passed on to the tabulating machines in the I.B.M. Department. Here girls made the tabulating cards on the key punch machine from the information on the wire recorder as it was played back. Following this operation the punched cards were placed in the multiplier, which multiplies mechanically to obtain the total dollar value of each item, thus eliminating the need for a comptometer operator. The last step is to feed the punched cards to the printing machine which produces the finished, printed inventory report automatically from the data.

The procedure eliminates four time-consuming clerical operations, each a potential source of error: 1) pencil work by the clerk taking the physical count, 2) manual posting of prices by clerks, 3) need for a comptometer operator for obtaining price values, and 4) typing the inventory report. It was found completely satisfactory in every respect on this trial run, and now is under consideration for adoption on a permanent basis. Plant officials point out, however, that the wire recorder method can be used to advantage only where automatic accounting machines of the I.B.M. type are also available.

The system of symbols utilized in the procedure, necessary because of the I.B.M. punched cards, was based primarily on a set of symbols already being used by the plant purchasing department. This involves a series of single digit numbers; for example, the first set for the broad classifications like valves, fittings, bolts, etc., the second set for individual type like gate valves, globe valves, angle valves, etc., and the third set for size, capacity, or any other essential characteristic.

Portable Office

Still in the planning stage for improved efficiency in maintenance is another trailer which would be designed to serve as a portable office for supervisors in charge of the various crafts, say on a specific unit turnaround. In general, this trailer would be about the same size as the mobile storehouse and tool room. It would be equipped with illumination, heating and ventilation, telephone and public address systems. Its interior would be arranged with a number of wall-type folding desks, filing cabinets, clothes lockers, and chairs.

The purpose is to provide a central supervision point or nerve center for a major maintenance project, a safe place for records, proper shelter for supervisors.

A 3-ton truck used in the telephone delivery system at Lockport. Note hydraulic tail gate to facilitate handling heavy items by one man

329 Hours Completed the Turnaround On a 28,000 b/d "Cat Cracker"

THOROUGH planning months ahead of the scheduled shutdown, plus the maintenance aids originally built into the unit, enabled the maintenance crews at Sinclair Refining Co.'s East Chicago refinery to set a record of 329 hours for the first turnaround on its 28,000 b/d, 22,000 lbs./hr. coke burning, fluid catalytic cracking unit.

The initial run of 20 months was completed on Oct. 23, 1949, at which time the unit had been scheduled for shutdown, cleanout, inspection, repair and revisions. It was placed on stream again Nov. 6th at 3 a.m., the record time taken for the shutdown enabling the unit to establish a stream efficiency of 97.8%.

Planning for the turnaround was in progress several months prior to the scheduled shutdown date. Under the supervision of the Area Coordinator, work lists were carefully screened at all times for work that could be done while the unit was in operation or for which fabrication could be done prior to the shutdown, thereby saving time and conserving manhours during the turnaround period. Material required was delivered to the unit beforehand and placed either in the area at ground level marked off and assigned to a given craft, or placed on the platform elevation near its ultimate point of use.

Install Communications

The usual procedure was used of spotting blinds where required and marking valves requiring packing or replacement. A communications system was installed beforehand with loudspeakers at strategic locations and the broadcasting equipment stationed in the control room, to be operated by one of the operating personnel on the unit. This was in addition to the sound-powered telephone system in normal use on the unit, and it provided a time-saving means of locating key personnel and issuing instructions.

To protect against delays caused by unsuspected necessary work revealed by detailed inspection, emphasis was placed on preparing the unit as quickly as possible for thorough inspection by the Inspection Department.

For expediting movement of materials from the storehouse and to and from the shops, a material dispatcher was stationed at a receiving point at ground level at the unit, at which location a temporary refinery phone had been installed. An expediter was placed at the storehouse, and one in the shops building. Two trucks and one hyster were assigned to the unit under the direction of the material dispatcher on the unit. With this group working in close harmony as a team, a minimum of time was consumed in expediting and transportation.

A field tool room was established in a temporary building adjacent to the unit area. Items anticipated to be in heaviest demand, including rainsuits, boots, hard hats, and goggles, were stored there.

General Meeting Held

Prior to the shutdown, a general meeting was held of the foremen of all departments directly or indirectly affected by the turnaround activities, to brief them as to timing and specific duties. In addition, daily meetings were held during the shutdown near the unit area and under the direction of the Maintenance Superintendent. At these daily get-togethers the progress of the work underway was discussed, and adaptations were made to the general work schedule in order to balance manpower versus known work to avoid bottlenecks that otherwise would arise.

Since the unit had operated on natural catalyst and also because the previous turnaround on a Fluid unit at the Marcus Hook refinery had shown the major points where erosion and corrosion might be anticipated, no unforeseen jobs occurred to cause major delay in the program at East Chicago.

The revisions to the unit during this first shutdown were dictated in the main by two factors: 1) to eliminate minor operating difficulties, and 2) to provide means of cleaning or repair with the unit in operation.

Both of these factors point toward a goal of insuring maximum "on-stream" time and minimizing "down" time. These, together with the fact that the maintenance foremen and craftsmen are now familiar with the unit and a minimum number of revisions should be required on future shutdowns, will definitely contribute toward bettering the 329 hours consumed for the turnaround in which a total of 37,213 straight time hours were required of hourly paid craftsmen and laborers. A summary of the Maintenance Department man hour distribution during the turnaround is shown in Table 1.

A detailed breakdown of the craft manhours by individual jobs also was made. This will be analyzed with the foreman of each craft in the light of experience gained during the turnaround. As a result it is believed standards can be set up for the next occasion incorporating improved methods which will provide for more efficient utilization of the manpower available.

TABLE 1—Summary of Manhour Distribution on Turnaround

Craftsmen	Manhours	Per Cent
Pipefitters	12,265	33.0
Boilermakers	4,380	11.8
Machinists	3,000	8.0
Welders	2,892	7.8
Labor	1,992	5.3
Burners	1,912	5.1
Riggers	1,905	5.1
Plug Gang	1,696	4.6
Carpenters	1,156	3.1
Electricians	1,113	3.0
Instrument Men	1,047	2.8
Insulators	996	2.7
Trucks-Hyster-Cranes-Grader	900	2.4
Painters	655	1.8
Masons	652	1.8
Gas Testers	345	0.9
Tinners	183	0.5
Blacksmith	124	0.3
TOTAL	37,213	100.0

First Run Is 608 Days

The accomplishment of maintaining operation of the Fluid unit on its maiden run for 608 days is credited to the outstanding engineering design job and to the perseverance of the operating personnel in guiding it through extremes of operation not ordinarily encountered in the start-up of a new unit. Since the fluid plant started to operate on Feb. 23, 1948, it preceded by several months the completion of the major feed preparation units. Consequently, its operations ran the gamut of varying feed rates and feed compositions, until it finally lined out on a normal feed rate of 26,000 to 28,000 b/d of various heavy gas oil fractions represented in general by that fraction of the crude boiling between 30 penetration asphalt and the Diesel fraction. Total fresh feed for the run was 11,954,628 barrels which at times ranged as high as 0.87 carbon residue.

The engineering design of the fluid unit at the East Chicago refinery was a close collaboration of Sinclair operators and engineers with the C. F. Braun & Co., refinery engineers, Alhambra, Cal. Operating and maintenance features were built into the unit which contributed both to the length of the run and the ease of turnaround.

Selection and Operation of Rotameters For Petroleum Processing Plants

By TYLER G. HICKS, Consulting Mechanical Engineer

Rotameters have found many applications in continuous distillation, natural gasoline processing, wax sweating, depropanizer and debutanizer overhead products blending, and viscosity measurement. A number of uses for various operations are discussed, with suggestions for proper arrangement. Recommended practices are given for the operation and maintenance of the instrument.

BASICALLY, a rotameter consists of a vertical, tapered, glass tube containing one or more floats which have diameters slightly less than that of the tube. Fluids to be measured flow through the tube and support the float at a height corresponding to the flow rate or the viscosity.

A graduated scale etched on the glass tube permits reading the flow rate or viscosity at any time desired. Or, if preferred, electromagnetic or other means may be used for transmitting the height of the float to any suitable recording or controlling instrument. Since the area through which the fluid can pass changes with the quantity flowing, due to the taper of the tube, rotameters often are called variable-area meters. The term "rotameter" is generic, covering all measuring instruments in which the indicating device floats in the fluid being measured. The term is not a trade name of any particular manufacturer. A typical installation of panel-mounted rotameters is shown in Fig. 1.

Rotameter Types

As would be expected, the type of rotameter selected for a given petroleum process depends on the fluid measured and flow conditions, steady or pulsating. Most fluids such as liquids, vapors, and gases can be measured with rotameters. Air, butadiene,

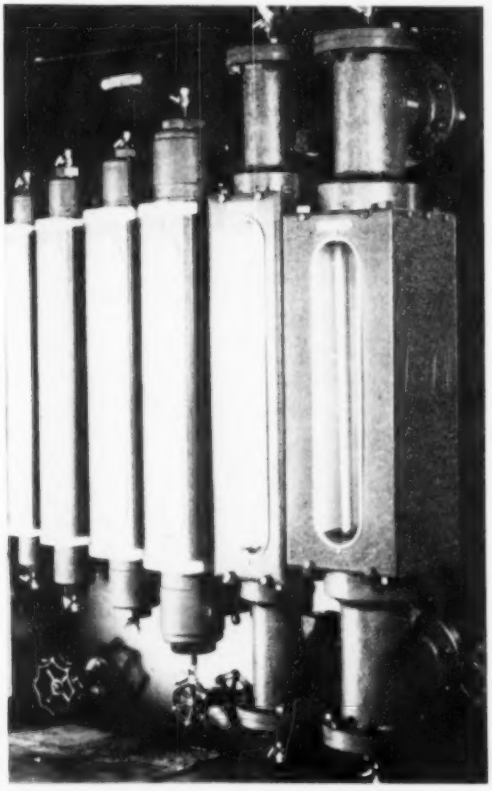
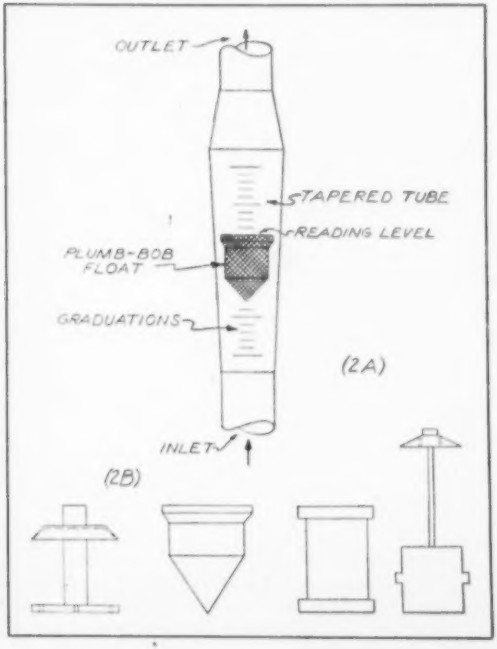


Fig. 1—Left: group of panel-mounted rotameters

Fig. 2A—Below: simplified diagram showing essential parts of a rotometer. Fig. 2B—Float shapes commonly used in petroleum operations: left to right: bead-guided, plumb bob, self-balanced, and guided



fuel oil, gasoline, lube oils, octane, propane, steam, water, toluene, and wax are a few of the more common fluids measured by rotameters in petroleum processes. The most common type of rotameter is that shown in Fig. 2A. There are a number of variations possible with this instrument; these include side inlet and outlet, bottom inlet and side outlet, dashpots for dampening flow pulsations, extension chambers for draining condensibles from vapors, use of several tubes to increase reading accuracy, batch control valve operators, orifice flanges for metering, and controlling and totalizing devices which are actuated by the float. However, regardless of type used, basic operating principles are the same.

In selecting rotameters it is common practice to supply the manufacturer with complete details of the fluid being handled and allow him to recommend the best unit for the job. At present, rotameter capacities are based on a 10:1 flow range from maximum to minimum. Maximum capacities are in the 6,000 gpm. range and minimum capacities in the 0.5 cc per min. range. Standardized floats are preferred in petroleum processing because they have a lower first cost and are easier to replace when damaged. Pressures up to 15,000 psi. are allowable in certain types of rotameters. Viscosities ranging between 0.0308 and 800,000 cent.poises can be measured, depending on the designed range of the instrument. Air flow rates between 85 and 12,500 cfm. at standard conditions can be handled by units now available.

Fig. 3A shows a group of rotameters applied to a typical continuous distillation unit. Certain of these are optional but accurate processing control requires that all those shown be used. That this is so can be seen by a brief study of the flow sheet.

The meter at 1 measures and records feed to the column and is essential for good control and complete evaluation of tower performance. The same is also true of the reflux meter at 2. Meter 3 is absolutely necessary because without it column operation could not be checked. Measurement of fraction draw-off at 4 is often needed to permit control of the process using the draw-off. To obtain a full picture of tower operation, the bottoms draw-off meter at 5 is necessary. With meters 1 through 5, every gallon of fluid entering and leaving the column can be checked and recorded during tower operation. When such readings are available, process results are certain to be as specified. Since cooling water is often an expensive item in water-scarce areas, a meter at 6 aids in water conservation and process control.

Fig. 3B shows an application of a rotameter, its control piping, and valves to a wax sweater. Installations such as these have proven useful and economical because the rotameter measures, records, and actuates control devices needed in the process. Either compressed air or electricity can be used for control valve actuation.

Materials

In selection and application of petroleum process plant rotameters, some knowledge of proper materials for the fluid handled is necessary. Table 1 summarizes materials used for rotameter parts when various common fluids are flowing. Although this tabulation is fairly complete, it should be used only as a general guide. Material specifications vary somewhat from one manufacturer to another and therefore it is necessary to use extreme care when ordering replacement parts. Glass tubes for most rotameters are made of borosilicate glass.

Operation and Maintenance

Give the petroleum plant operator good instruments and production will be high in quality and of sufficient volume to meet output specifications.

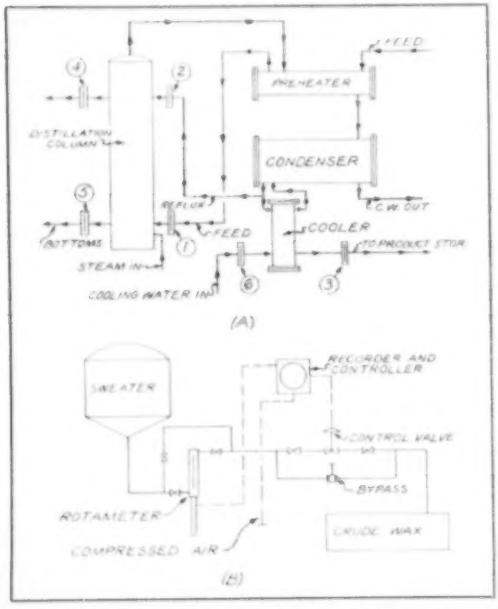


Fig. 3A—Rotameters used in conjunction with a continuous distillation unit. Fig. 3B—Rotameter for flow measurement, recording, and control in wax sweating

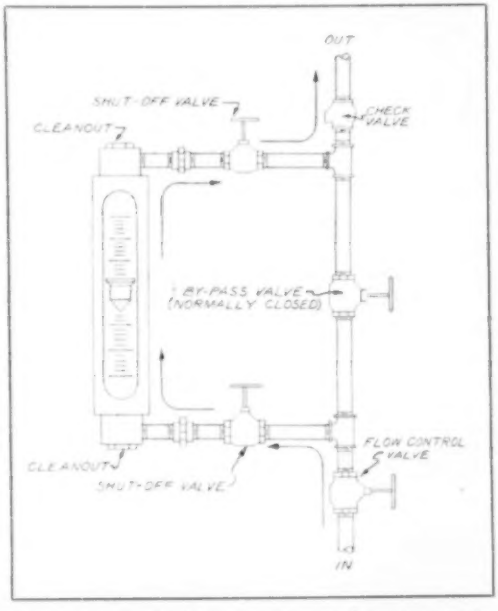
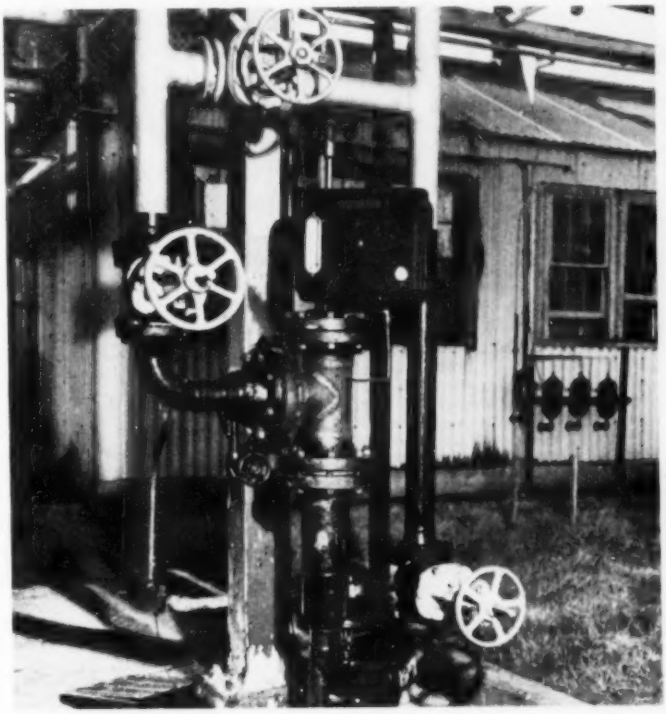


Fig. 4—Approved piping arrangement for rotameter installation. By-pass, check valve in outlet, and vertical position of the meter assure accurate readings

This is a theory advanced by all experienced designers of petroleum processing plants. In all cases good instruments will aid production but the instruments themselves must be kept in topnotch working order by plant personnel. No matter how well constructed and adjusted before it left the factory, there comes a time in the life of every instrument when it must be cleaned, repaired, or readjusted. These jobs come under the heading of rotameter operation and maintenance and are usually performed by the plant operating crew. Rotameters have been so widely applied to petroleum processing that a knowledge of good operating and maintenance methods is necessary for low cost production.

In general, rotameters are best installed in a vertical position, Fig. 4. Connecting piping should be properly aligned to prevent placing a strain on the instrument casing. Bypass piping around the rotameter is always advisable in order to permit continuation of petroleum production during periods of instrument repair. A check valve in the instrument outlet piping will prevent backing up of the fluid measured. If the check valve is not used a high back pressure may cause jamming of the float and breakage of the glass tube. When starting flow through the rotameter, the control valve is opened slowly to prevent slamming of the float against the top of the tube. Flow at a moderate rate is allowed until the float is steady, then the control valve is opened to the desired position.

Only a soft cloth, wet with carbon tetrachloride or acetone should be used for cleaning the exterior and interior of the instrument. Special care should be exercised to prevent scratches and nicks on the glass tube or float; otherwise, instrument accuracy may be impaired. Floats and tubes should never be left in an exposed location on a bench or table. These parts are fragile and readily damaged. Instrument cleaning should always be done carefully and thoroughly. Pieces of lint, dirt, or grease left on the float or in the tube may reduce instrument accuracy and affect petroleum production. Cleaning frequency depends on fluid handled, atmospheric conditions at instrument location, and general cleanliness of the plant. It is best to disassemble and reassemble only one rotameter at a time. This will prevent accidental switching of floats. Some floats are interchangeable but the accuracy obtained after changing is not always as good as with the original float. Packing screws should be tightened evenly, a little better than "hand tight" is quite sufficient.



Typical field installation of a rotameter type pneumatic flow transmitter measuring acid transfer between reactors in an alkylation plant

TABLE 1—Corrosion Resistant Materials for Rotameters

Fluid measured	Fittings	Float	Packing
Air	brass	aluminum or stn. steel (303)	Neoprene
Butadiene	iron, steel, brass	303 stn. steel, aluminum	Thiokol
Butane	iron, steel, brass	303 stn. steel, aluminum	Neoprene
Butylene	iron, steel, brass	303 stn. steel	Neoprene
Crude oil	iron, steel	303 stn. steel	Neoprene
Ethane gas	iron, steel, brass	303 stn. steel, brass	Neoprene
Ethylene glycol	brass, steel	303 stn. steel	Neoprene
Freon	brass, steel	303 stn. steel, aluminum	N. F. Neoprene
Fuel oil	iron, steel	303 stn. steel	Neoprene
Gasoline	iron, steel, brass	303 stn. steel, Plasmet	Ameripol
Heptane	iron, steel	303 stn. steel	Neoprene
Hexane	brass	303 stn. steel, aluminum	Neoprene
Kerosine	iron, steel, bronze	303 stn. steel	Ameripol
Lube oils	brass	303 stn. steel	Neoprene
Naphtha	iron, steel bronze	303 stn. steel	Ameripol
Octane, iso-	brass	303 stn. steel	Ameripol
Petrolatum	iron, steel	303 stn. steel	Neoprene
Propane	iron, steel	303 stn. steel	Thiokol
Steam	iron, steel	303 stn. steel	Blue African Asbestos
	(Bronze or stn. steel tube is generally used.)		
Toluene	iron, steel	303 stn. steel	Thiokol
Water (fresh)	brass	303 stn. steel	Neoprene
Water (sea)	bronze, Monel	bronze, Monel	Neoprene
Wax	iron, steel	303 stn. steel	Neoprene

Note: stn. steel = stainless steel

Conclusion

Rotameters occupy an important place in modern petroleum processing. Process plant operators throughout the U. S., and the world as well, have found well-built rotameters to be dependable, compact, and well suited for petroleum flow and viscosity measurements. Proper application requires use of corrosion resistant materials and an instrument with a suitable flow range. Flow range is best selected by the rotameter manufacturer after a complete study of process conditions.

Good installation and proper maintenance are operating crew jobs. The brief discussion given here can serve as a starter for further study.

Photo Credits

Figs. 1—4 courtesy Fischer & Porter Co. Picture of field installation in an alkylation plant courtesy Humble Oil & Refining Co.

NEW VENT VALVE DESIGN

Sheet Steel and Spun Aluminum Fabrication Will Make Practicable Construction of Larger Valves to Take Care Of Future Pumping and Storage System Requirements

By GEORGE STEWART, Chief Engineer
Johnston and Jennings Co.

GREATLY increased capacity of pumping facilities has necessitated the re-design of many accessories commonly used with petroleum storage tanks at refineries and tank farms. Increased pressures, larger piping, and greater attention to proper safety practices have all played their part in the growth and development of vent valves, flame arrestors, and similar equipment.

The steady increase in the required minimum capacity of these devices has forced manufacturers to alter their designs to provide the required operational features while maintaining size, weight, and other construction factors within practical limits.

Typical of such accessories are the "Occeco" vent valves, used on liquid or gas storage tanks to control breathing and minimize vapor loss. A few years ago, the most common sizes for these valves were 2, 4, and 6-in. diameters. Today, 10 and 12-in. valves are commonplace. There already are indications that these sizes may prove inadequate for future storage systems.

Until recently, these valves were made from cast-iron components. Both the valve and hood were castings, requiring costly machining, drilling, and other operations. In addition these valves were quite heavy.

By constructing these vent valves from fabricated sheet steel shells and spun aluminum hoods, weights are reduced, installation simplified, and manufacturing costs lowered. The new 10-in. valve weighs 122 lbs.; the 12-in. valve weighs 147 lbs., reflecting an effective weight reduction. The shell is formed from 14-ga. sheet steel, arc-welded into a lightweight assembly.

Machining Is Eliminated

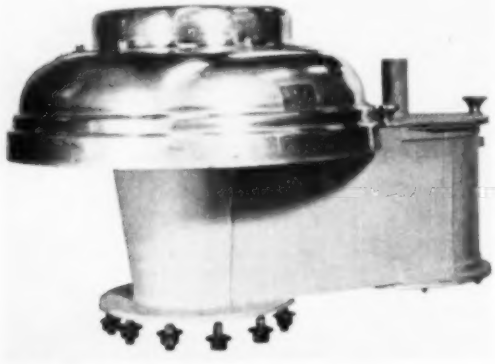
Machining has been completely eliminated by the use of threaded studs end-welded to the valve body. By employing simple locating templates and the "Nelson" hand-operated stud-welding gun, four sizes of studs are welded in place around the perimeter of the valve body, using a single 400-amp. welding generator.

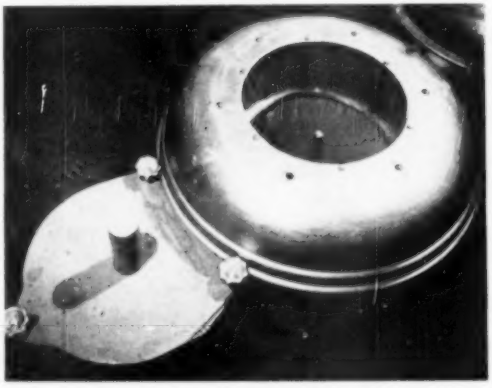
The screen and the aluminum hood are fastened to the body by female extension rods, threaded onto six $\frac{3}{8}$-in. studs welded to the body. Eight $\frac{1}{4}$-in. studs secure the vacuum valve seat to the body, and two $\frac{1}{2}$-in. studs fasten the vacuum cover plate to the top of the body.

Specially designed $\frac{3}{4}$-in. threaded studs with a $\frac{1}{2}$-in. weld base are the fourth type of stud used in the construction of the valve. Since $\frac{3}{4}$-in. is the conventional thread diameter for securing the vent valve to flame arrestors, this dimension could not be changed. However, welding a stud of this size would require three 400-amp. generators in parallel, so the welded base was reduced to $\frac{1}{2}$-in. As a result, all studs require only a single welding generator. Tests have proved adequate strength is developed in the stud, although the weld base is 1.3 less than the thread diameter.

Shipment of the new type valves has been simplified because they are packaged safely in lightweight, wood boxes. A further advantage of the new design became apparent during field installation. Two men can easily carry the 12-in. valve up the tank ladder.

Below: Redesigned vent valve for petroleum storage tanks uses spun aluminum hood and fabricated sheet steel valve body, replacing former iron castings at substantial saving in weight. Studs seen at bottom of body are $\frac{3}{4}$-in. diam. with a $\frac{1}{2}$-in. diam. end weld





Above: This view of the assembled vent valve shows the extension rods used to fasten the hood to the body. The cover plate at the left of the picture is held in place by three $\frac{1}{2}$-in. studs, end-welded in place by means of a new stud-welding gun and a simple template

THE SOLVENT EXTRACTION OF ASPHALTIC RESIDUES

By H. E. SCHWEYER and O. M. BROWN*

Department of Chemical Engineering, University of Florida

Solubility relationships for several n-butanol-asphalt systems were studied over a temperature range of from 50° F. to 200° F. The data were analyzed by the modified ternary method employed for petroleum oils using a weight basis. The results obtained indicated certain anomalies for the effect of temperature on solubility analogous to those found in propane de-asphalting. The results were specific with each system studied, but they show that asphaltic materials may be fractionated through the selective solvent action of normal butanol at certain temperatures and solvent ratios.

FRACTIONAL separation of asphaltic materials into their component parts by ordinary distillation procedures is not feasible because of the low vapor pressures of the various compounds present. Furthermore, since asphalts are mixtures of high molecular weight hydrocarbons of substantially unkown composition and the quantities of each pure compound are present only in minute proportions, the separation by special distillation procedures (such as high vacuum) would be expected to yield separations based on molecular size (incremental increase in molecular weight).

However, the majority of the uses for asphalts depend to a considerable extent upon their chemical nature (although differences among asphalts are measured by physical tests) and a method for obtaining specific types of high molecular weight materials from asphaltic residues is not only desirable, but is potentially a feasible economic process. For example, many such residues now being used for fuel might readily prove to be a source of special lubricants or unique asphaltic materials that could be sold profitably at a price to pay for the separation operations. The use of selective solvents appears to be a means of effecting such separations, and it is the object of this paper to present certain results obtained when using normal butanol for this purpose.

Since 1930 the use of solvent extraction processes has increased enormously in the field of high grade lubricating oils, transformer oils, and similar materials, but their application to asphaltic residua has not been as extensively studied because the commercial value of asphaltic products is not as great as for the other materials derived from petroleum.

Propane is extensively used as a selective solvent in lubricating oil processing at the present time, due to its ready availability and certain desirable physical properties. It exhibits a loss of solvent power as the temperature is raised above 80° to 100° F.[4,10]. Below this range it behaves like a normal solvent in that larger amounts of solute are dissolved with rise in temperature. The abnormality in the upper range is probably due to the proximity of the higher working temperatures to the critical point of 205° F.

With the semi-hard and hard asphalts this loss of solvent power at elevated temperatures is not desirable because temperatures of 190° F. or higher are necessary to render the asphalts sufficiently fluid to insure uniform mixtures. In addition, the use of propane at temperatures near the critical temperature (205° F.) requires special equipment because of the pressures involved (critical pressure — 42 atms.) It therefore would be advantageous to find a solvent with comparable solvent properties which could be used at higher temperatures.

The occasional use of various butyl alcohols as selective solvents can be found in the literature. Ellis[3] and Thompson[9] give processes for treating lubricating and other oils using tertiary butanol. In this process the material was heated to put it in solution and then cooled to precipitate wax and asphalt. Zwergal[11] discusses and gives data on the separation of petroleum asphalts by fractional solution. Asphalts of four different origins were extracted using methyl, ethyl, propyl, butyl (exact one not stated) and amyl alcohols. A compilation of properties; ash and elementary analyses of the various fractions showed but small differences. Hoiberg and Garris[5] suggested the use of iso-butanol for a procedure in analyzing asphalts, but the method was not proposed as a commercial process.

It is interesting to note that no reference to the definite use of normal butanol as a selective solvent for asphaltic products has been found in the literature. Certain unpublished data, however, have indicated its potential use with asphalts because the results obtained were similar to those for propane. Normal butanol has a boiling point of 244° F. and a critical temperature of 549° F. which permits using the relatively high operating temperatures necessary for mixing hard and semi-hard asphalts with the solvent at ordinary pressures, thus obviating the need for specially designed equipment. In addition, normal butanol has a sufficiently low boiling point, compared to the petroleum materials involved, to permit its removal from them by distillation. These factors, together with its ready availability in commercial quantities, point to the feasibility of using normal butanol as a selective solvent for asphalt.

The development of a commercial solvent extraction process for asphalts using normal butanol requires a knowledge of the temperature-solubility relations for a variety of asphalts, since the latter may vary considerably in composition. In the present study the asphalts considered were of various types to meet this requirement. Although there undoubtedly are asphalts of special or peculiar properties which are not covered here, each of these would need to be considered as a special problem. Descriptive data for the materials studied are given in Table 1. Temperature-solubility data on these asphalts were determined over the range from 50° F. to 200° F. by refluxing the samples, at atmospheric pressures, in various amounts of n-butanol, permitting the samples to separate into two phase systems at constant temperature for 12 to 18 hrs. and then centrifuging at the equilibrium temperature selected. The two layers were separated, and the amounts of solvent-free extract oil and raffinate oil and their densities were then determined.

The data were plotted on ternary

* Present address: Ethyl Corp., Baton Rouge, La.

TABLE 1—Properties of Asphaltic Materials Used

Sample	TA-1023	TA-1024	TA-1025	TA-1026	S-13
Identification	Gulf Coast Naphthenic	East Texas	East Cent. Texas	South Texas Heavy	Florida Sunniland
Density at 60° F. (15.6° C.)	0.9658	1.0215	1.0205	0.9948	1.0006
Viscosity, Saybolt Furol Seconds, 210° F. (98.9° C.)	118			85	79
Ring and Ball Softening Point, °F.		100	98		
Penetration, 77° F. (25° C.)		227	263		
Per cent Asphaltines[a]	12.7	40.6	33.6	3.3	19.3
Per cent Asphaltenes[b]	2.0	27.9	22.0	1.9	16.0

(a) Per cent insoluble obtained by filtration with 40 volumes of normal butanol at 77° F. (25° C.) after refluxing and standing 12 hours.
(b) Determined with n-pentane using ASTM Method D165-42 with a one gram sample.

diagrams using the method of Hunter and Nash[6] on a weight basis from which yields[9] and other pertinent commercial data may be estimated. The detailed procedure is given below.

The feasibility of separating asphaltic residua by selective fractionation with n-butanol is a function of temperature and asphaltic content. Thus, the South Texas Heavy residuum was not amenable to separation at temperatures of 100° F. and 200° F. with solvent to residuum ratios over the range of 0.6 to 9 because two definite phases could not be separated readily with the technique employed. (Higher solvent ratios might produce some separation at these temperatures, but would probably not be practical for commercial operations). Similarly, the Gulf Coast Naphthenic residuum could not be separated into two phases at 200° F.; at 52° F. and 100° F. two phases were separated, but practically no selectivity was obtained. The separation of the Florida residuum at 200° F. also gave two phase systems that were too difficult to separate by the procedure used, although at the lower temperatures the separations were made readily. With the highly asphaltic materials such as East Texas and East Central Texas, the separations of the two phases presented no serious difficulties.

Detailed Procedure

Pour approximately 10 gr. of the melted residuum into a weighed 250 ml., 60 x 142 mm. Pyrex flat bottomed centrifuging flask and allow it to cool. Weigh this accurately to the nearest hundredth of a gram, and obtain the weight of the residuum by difference. Calculate the proper weight of normal butanol* to be added to give the desired per cent butanol and add this amount (on the same balance), using a pipette to aid in metering the final amount. Convenient weights to use with the 60 x 142 mm. flat bottomed Pyrex centrifuging flasks in order to obtain various percentages of butanol are such as to give a total charge of 100 grams. In the experiments reported here six mixtures consisting of 10, 20, 30, 40, 50, and 60 %-wt. of asphalt were used in all but one run.

Reflux each charge 15 min. on an electric heater using a vertical air condenser approximately 3 ft. in length. Adjust the heat to obtain condensation at the rate of about 20 drops per minute. Care must be taken to avoid overheating of samples containing a low percentage of butanol to avoid bumping and carry over of residuum into the condenser.

After refluxing, place the samples in a constant temperature oven or constant temperature bath for 18 hrs. to allow them to attain equilibrium. Centrifuge the samples in a constant temperature room, or in a centrifuge at constant temperature at a relative centrifugal force of 1060 times gravity until a clear extract is obtained. With mixtures containing 70% butanol or more, it is sometimes impossible to obtain a completely clear extract with the centrifuge used, and in these cases a 45 min. maximum centrifuging time was set arbitrarily for convenience.

After centrifuging the mixture, decant the extract (top layer) into a previously weighed 250 ml. Erlenmeyer flask. Care must be taken to separate the extract and raffinate as completely as possible. To effect this separation it is sometimes necessary to use a pipette to remove the last portion of extract due to the fact that the extract and raffinate are often very nearly the same viscosity. The raffinate is allowed to remain in the Pyrex centrifuging flask. Obtain the weights of extract and raffinate by difference. The total of these two weights should be equal to the original weight of residuum plus butanol (or total charge).

The extract is heated directly in the flask to remove the butanol by using a water-jacketed condenser. The extract may be evaporated to a point where the temperature of the vapor just begins to exceed that of the boiling point of the normal butanol (244° F.). Remove the last trace of butanol in a constant temperature oven at 325° F. Completeness of evaporation may be determined by drying to a constant weight. Dry the raffinate by placing it in a constant temperature oven at 375° F. After drying, the combined weights of extract oil and raffinate oil should be equal to the weight of residuum in the original sample. For the runs reported herein, losses averaged less than 0.5% of the charge, and all losses were apportioned in proportion to the amounts of the oils recovered.

Determination of specific gravity and density of the extract oil and the raffinate oil is made in special pycnometers (described below) adapted to the unusual properties of these substances. For the extract oil a 200 mm. length of 7.5 mm. capillary tubing is used as a pycnometer. This is a convenient size for use with the ordinary laboratory analytical balance. A slight bend should be made in the tubing to prevent rolling from the balance pan. The volume of the pycnometer described is approximately 0.5 ml; it is obtained by calibration with water.

To determine the density of the extract oil, the pycnometer is filled with the oil. This may be done by using a length of suction tubing and a water aspirator to apply a vacuum at one end of the pycnometer while the other end is submerged in the oil being tested. For extract oils that are especially viscous at room temperatures it may be necessary to heat to a temperature of about 200° F. to facilitate filling of the pycnometer. The pycnometer is allowed to reach to room temperature and excess oil from the ends is removed. After weighing to four places and noting the room temperature, the density of the oil at that temperature can be computed from the calibrated volume of the pycnometer. It is customary to convert the density of petroleum products to a standard temperature of 60° F. This may be done by using the conversion tables given in the ASTM Standards D-206-36[1]. A group number for the oils determined by the gravity (degrees, API) is furnished at the beginning of these

TABLE 2—Weight Additivity of Densities of Extract Oil and Raffinate Oil

	Weight Per cent[a]	Experimental Density, D_x	Wt. % x D_x
TA-1024			
Raffinate Oil	55.0	1.0136	0.5742
Extract Oil	15.0	0.8842	0.4427
Mixture		1.0163	
Calculated Density			1.0169
TA-1025			
Raffinate Oil	56.5	1.0326	0.5836
Extract Oil	43.5	0.9593	0.4171
Mixture		1.0005	
Calculated Density			1.0007

(a) Not combined in proportion to fractionation of source material.

* Synthetic grade, having a boiling range of 2.7° F. including 244° F.

tables. The density may be determined by the relation.

$$\text{Density at } 60^\circ \text{ F.} = \frac{\text{Wt. Oil}}{(\text{Vol. Pycnometer})(\text{Multiplier})}$$

Specific gravity of the raffinate oil should be measured by the ASTM method (D70-27)[2] using a standard ASTM pycnometer for asphaltic cements or any other equally precise method can be used. Since the specific gravity is determined at room temperature it is necessary to convert it to specific gravity at 60° F. by use of the ASTM correction tables. The specific gravity may be converted to density by multiplying by the density of water at 60° F. (0.9990 gms./ml.).

From the data obtained by the foregoing procedures, the following information may be calculated in order to plot an equilibrium diagram on a ternary chart.

(1) Per cent butanol in charge.
(2) Density of charge.
(3) Per cent butanol in extract.
(4) Density of extract oil.
(5) Per cent butanol in raffinate.
(6) Density of raffinate oil.
(7) Lever arm ratio (Wt. extract/Wt. raffinate).
(8) Per cent extract oil from original asphalt.
(9) Per cent raffinate oil from original asphalt.

The equilibrium diagram can be plotted from these data in the following manner. Divide the lower side of a ternary diagram into a scale of density such that the lowest extract oil density falls near the left hand side of the line and the highest raffinate oil density falls near the right hand limit of the scale. This scale will coincide with the 0% butanol line. Draw a straight line which will connect the 100% normal butanol apex (top of diagram) with the density of the charge stock. Any point on this line (charge stock line) will represent a definite mixture of butanol and charge stock, with the per cent butanol by weight being indicated directly on the chart.

A line is then drawn connecting the butanol apex with the density of the solvent free extract oil on the 0% butanol line. The extract point is then located on this line at the appropriate butanol content of the extract. The process is repeated for the raffinate side to locate the raffinate point. A line connecting the raffinate and extract points is a tie-line which passes through the charge stock line at the butanol-charge composition point. The relative lengths of the lever arms (on each side of the charge stock line) will be the amount of extract and raffinate obtained after the system has been separated into the respective phases. (Note: all of the tie lines are not shown on the diagrams in order not to confuse the charts).

An alternative method of plotting can also be used. In this method the extract point is located as before and the distance from the extract point to the butanol-charge composition point is determined graphically along a straight line. This line and its length represent the segment of the tie line corresponding to the proportion of raffinate present. Thus, the length of the tie line corresponding to the amount of extract can be computed from the experimentally determined ratio of extract to raffinate. The tie line can then be extended to its full length, the terminus of which will locate the raffinate point. This point, determined graphically, should check the butanol content of the raffinate obtained by direct measurement. In addition, a line drawn through the raffinate point from the apex (100% butanol) should intersect the 0% butanol line at the value for the density of the raffinate oil.

The first method is preferred because all plotted points are determined experimentally and the latter method can be used for checking. For those cases where it is impossible to determine the density of the raffinate oil directly, the density may be computed from the available data assuming weight additivity for the densities of mixtures of the extract and raffinate oils. (Several cases of this nature were found as noted on the tabulated data). By determining a series of extract points and raffinate points for different solvent-asphalt ratios, as explained above, a smooth curve describing the system at any one temperature may be constructed.

It is recognized that the method of plotting used assumes that densities are additive by weight, whereas a plot using a specific volume would be more accurate. It has been found that densities are additive by weight over the range involved for the materials considered in this study as exemplified by the results in Table 2. That is, the sum of the products of the weight fractions of each component times their respective densities is equal to the value of the density for the mixture. Weight additivity of density is also illustrated in the other tables of data, where calculated densities are shown to be within the limits of experimental error when the effects of incomplete removal of solvent and polymerization of the fractions caused by heating to remove the solvent are considered. For all practical purposes any change in mixing these heavy fractions from a given source may be neglected since the densities of the extract oils and raffinate oils vary over a rather limited range. The results confirm those of Kurtz[7], who pointed out that the use of a weight per cent basis is more convenient and for all practical purposes substantially identical results are obtained as when using the more accurate specific volume.

This triangular method of plotting based on the work of Hunter and Nash[5] uses a density scale to differentiate the extract oil and raffinate oil since the variability in their compositions with the conditions of the extractions precludes their use as the apices of a triangle. Although this method of studying asphalt-solvent systems may be criticized from a theoretical viewpoint, it does provide a means for visualizing the various factors affecting butanol-asphalt systems and enables different butanol-systems to be compared with more convenience than is available by any other method.

Results

Experimental extractions were made at 50° F., 100° F. and 200° F. where feasible, on the residua listed in Table 1. Check runs (shown on the figures as cross marks) were made on selected samples to test the reproducibility of the data or to confirm unusual curves as shown in Figs. 1 and 3. As shown by the figures the data for certain of the raffinates do not fall on smooth curves. However, the isotherms have been drawn as the best smooth curve pos-

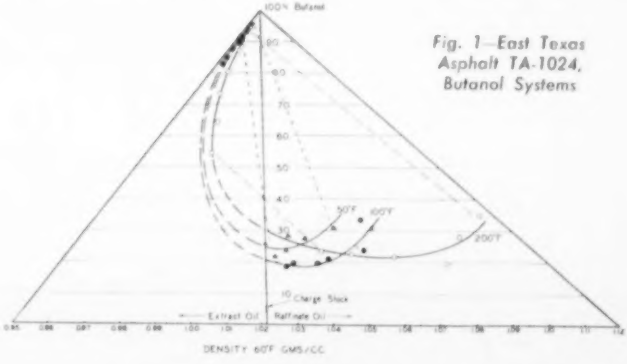


Fig. 1—East Texas Asphalt TA-1024, Butanol Systems

TABLE 3—Extraction Data for East Central Texas Asphalt, TA-1025 at 50° F., Run S-44

Sample	Wt. % Butanol in Charge	Wt. % Butanol in Extract	Density of Extract Oil at 60° F.	Wt. % Butanol in Raffinate	Density of Raffinate Oil at 60° F.	Arm Ratio Wt. Ext. Wt. Raff. (Expt.)	Wt. % Extract Oil in Chg.	Wt. % Raffinate Oil in Chg.	Calculated Density of Charge(a)
1	99.3	93.6	0.9874	46.0	1.0084	11.9	58.4	41.6	1.0336
2	89.2	88.2	0.9869	33.1	1.0477	5.7	59.2	40.8	1.0171
3	79.9	86.2	0.9803	27.6	1.0366	2.7	33.4	66.6	1.0178
4	60.3	86.40	0.9857	17.3	1.0309	1.6	20.9	79.1	1.0173
5	50.0	83.5	0.9873	19.3	1.0301	0.9	15.7	84.3	1.0203
6	40.3	80.5	0.9870	24.2	1.0269	0.4	9.4	90.6	1.0213

(a) Assuming weight additivity — average of five — 1.0212.

TABLE 4—Extraction Data for South Texas Heavy Residuum, TA-1026, at 52° F. Run S-46

Sample	Wt. % Butanol in Charge	Wt. % Butanol in Extract	Density of Extract Oil at 60° F.	Wt. % Butanol in Raffinate	Density of Raffinate Oil at 60° F.	Arm Ratio Wt. Ext. Wt. Raff. (Expt.)	Wt. % Extract Oil in Chg.	Wt. % Raffinate Oil in Chg.	Calculated Density of Charge(a)
1	90	90.5	0.9882	59.5	1.0309	79.6	95.0	5.0	.....
2	80	83.0	0.9865	23.6	1.0009	20.2	81.8	18.2	0.9887
3	70	76.2	0.9868	18.6	0.9954	8.3	70.8	29.2	0.9895
4	60	70.7	0.9876	23.2	0.9955	3.4	56.7	43.3	0.9911
5	50	66.7	0.9883	22.8	0.9918	1.6	41.1	58.8	0.9904
6	40	63.0	0.9900	26.9	0.9911	0.6	23.0	77.0	0.9908

(a) Assuming weight additivity average of five — 0.9901.
(b) Calculated based on average in (a).

sible except for certain regions on the extract side where other information was available to indicate that a break in the curve was real. Considering the complexity of the systems under study and the various possibilities for error in the experimental technique, the results are believed to be as satisfactory, from a precision standpoint, as those reported in the literature for solvent extraction studies where actual data have been shown[9].

The results obtained are illustrated in Figs. 1 to 4 and typical data are shown in Tables 3 to 6. Not all data are tabulated in order to conserve space.

From all of the curves obtained in this study, it is seen that the portion of the curve near the plait point (single phase areas) is dotted. From a consideration of the mechanics of plotting this type of graph, it can be seen that it is impossible to obtain tie lines which are completely to the left of the charge line. A method for obtaining this portion of the curve for lubricating oils when the data were plotted in the same manner was suggested by Meulen[8]. The method consisted of mixing some of the extract oil with the original charge stock to obtain a new charge line (to the left of the original one in the case of the normal butanol-asphalt system). This method would make it possible to obtain tie lines for the dotted portion of the curve. This is of academic interest only since the portions of the curve of most interest are those actually obtained with a given charge stock. In addition, the quantities of materials obtained in the present experiments were insufficient to employ this technique with confidence.

The solubility curves shown in Fig. 1 for East Texas Asphalt may be considered typical of the complex results expected for butanol-asphalt systems. Such systems separate into two phases at concentrations of solvent exceeding that at the point of intersection of the solubility curve and the line connecting the 100% solvent point and the density of the charge stock. The extract (upper layer) contains the lower density materials present in the charge stock and the raffinate usually contains the heavier asphaltic materials. A study of the isotherms in the extract region shows them to be normal with the 100° F. one enclosing the higher temperature one, indicating greater solubility for the latter. However, on the raffinate side an anomaly appears since the 100° F. line crosses the higher temperature line. This latter effect is confirmed and accentuated by the 50° F. isotherm. Furthermore, there is indication that the 50° F. line crosses the 100° F. line on the extract side but this is difficult to confirm because the densities of the extracts vary only slightly.

These results indicate that the relative effect of varying the temperature on the densities of solvent-free raffinate oils and extract oils does not proceed in an orderly manner and is affected by the temperature range and solvent ratios employed. As will be shown later, the nature of the charge stock will also influence the configuration of the curves as might be expected from the fact that asphaltic materials vary considerably in chemical composition. The results, therefore, are specific with each individual system.

The peculiarities found for these

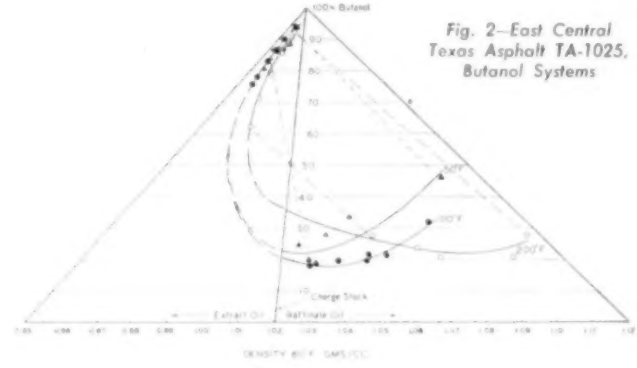


Fig. 2—East Central Texas Asphalt TA-1025, Butanol Systems

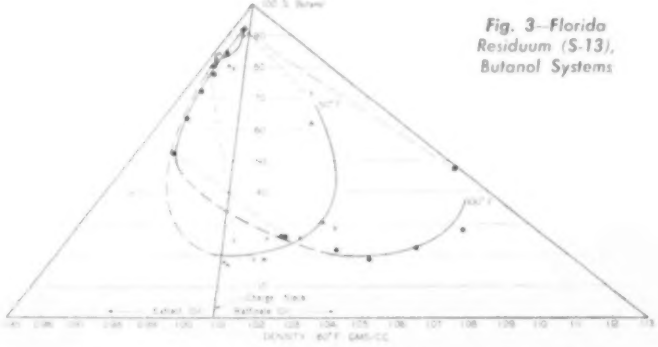


Fig. 3—Florida Residuum (S-13), Butanol Systems

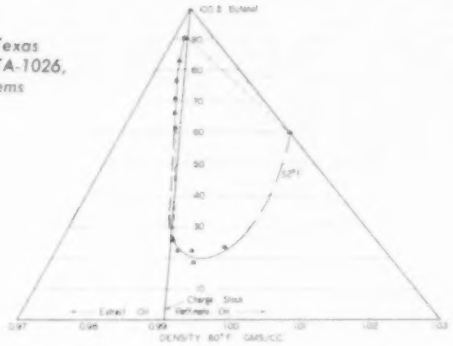


Fig. 4—South Texas Heavy Residuum TA-1026, Butanol Systems

systems are similar in several respects to those for propane-asphalt systems. With propane (as with butanol) the extract phase contains the higher percentage of the solvent, while the raffinate consists principally of the high density constituents of the charge and contains a relatively smaller proportion of the solvent. Propane-asphalt systems show a decrease in solubility in the temperature above about 100° F. whereas the solubilities decrease with decreasing temperature below about 80° F. Data given by Wilson, Keith and Haylett[10] show that the solubility line for one residuum and propane at 165° F. encloses the line for the same material at 136° F. At a low temperature range it would be expected that the curve might also enclose the line at 136° F. (because of decreased solubility) but no data were shown.

As shown in Figs. 2 and 3, the results obtained with the East Central Texas asphalt and the Florida residuum were similar to those obtained for the East Texas asphalt but the actual configuration of the curves varied with the charge stocks. The curve in Fig. 4 was the only one obtained for the two other residua either because of experimental difficulties in separating the two phases or because no selectivity was obtained. In the case of the South Texas Heavy residuum the small quantity of asphaltic material and its naphthenic nature precluded selective action by the solvent. At 100° F. the charge stock was almost completely soluble in the solvent.

Extraction data for the Gulf Coast Naphthenic residuum are shown in Tables 5 and 6 for temperatures of 52° F. and 100° F. Two brown colored phases could not be separated at 200° F. with the technique used. The data in Tables 5 and 6 were not plotted because, with the exception of the runs at 9 to 1 ratios of solvent to charge, practically no selectivity was obtained. It is interesting to note the data in Table 7 which show that the quantity of extract oil from this low viscosity stock was very low compared to the quantities from the other stocks. This stock contains considerable wax and this residue from the crude oil may contain considerable paraffinic materials having a low solubility in n-butanol. This theory is confirmed somewhat by the low density of the charge and the trend of the data which indicate at low solvent ratios that the solvent is rejecting paraffinic materials to the raffinate oil thus decreasing its density. Apparently, the use of different solvent ratios alters the solubility relations sufficiently to permit differences so that in the range of high solvent ratios the stock acts in a manner similar to the others.

The extracts were usually dark green to a dark brown in color using normal butanol as a solvent. However, in the case of the East Central Texas and Florida charge stocks a definite difference in color was recognized when the per cent solvent was increased from 60 to 70 at 50° F. Below 60% the extracts were all dark green in color, but above 70% a marked change occurred since a finely divided colloidal brownish colored material was present that could not be settled at a force of 1060 times gravity. This distinct change in color was confirmed by a sharp increase in density of the solvent free extract oil. (This effect was not noted for the East Texas charge at any of the temperatures studied). Thompson[8] mentions the same difficulty with secondary and tertiary butanols. Based on the above results the isotherms were shown with a definite break on the extract side for certain curves.

The asphaltic portion separated by the method presented in this study is quite interesting. The only limit on the density of the raffinate is that imposed by the slope of the tie lines and the amount of butanol used for extraction. With higher percentages of butanol, a relatively larger amount of the higher molecular weight materials (paraffins and ring compounds with side chains) will be extracted leaving an asphaltic raffinate containing the higher molecular weight materials. This asphaltic fraction is of high density, quite hard

TABLE 5—Extraction Data for Gulf Coast Naphthenic Residuum TA-1023, at 100° F. Run S-50

Sample	Wt. % Butanol in Charge	Wt. % Butanol in Extract	Density of Extract Oil at 60° F.	Wt. % Butanol in Raffinate	Density of Raffinate Oil at 60° F.	Arm Ratio Wt. Ext. Wt. Raff. (Expl.)	Wt. % Extract Oil in Chg.	Wt. % Raffinate Oil in Chg.	Calculated Density of Charge(a)
1	90	93.9	0.9506	28.2	0.9792	17.2	58.3	41.7	0.9678
2	80	93.8	0.9727	11.6	0.9649	14.85	25.4	74.6	0.9669
3	70	99.0	0.9674	15.5	0.9664	2.7	23.8	76.2	0.9666
4	60	88.3	0.9758	11.6	0.9649	1.6	17.4	82.6	0.9663
5	50	87.3	0.9725	15.8	0.9649	0.9	11.8	88.2	0.9658
6	40	86.8	0.9748	18.1	0.9647	0.5	7.2	92.8	0.9654

(a) Assuming weight additivity — average of six — 0.9665.

TABLE 6—Extraction Data for Gulf Coast Naphthenic Residuum, TA-1023, at 52° F., Run S-47

Sample	Wt. % Butanol in Charge	Wt. % Butanol in Extract	Density of Extract Oil at 60° F.	Wt. % Butanol in Raffinate	Density of Raffinate Oil at 60° F.	Arm Ratio Wt. Ext. Wt. Raff. (Expl.)	Wt. % Extract Oil in Chg.	Wt. % Raffinate Oil in Chg.	Calculated Density of Charge(a)
1	90	95.3	0.9595	23.1	0.9693	12.7	43.7	56.3	0.9650
2	80	93.8	0.9666	16.6	0.9659	4.6	26.1	73.9	0.9660
3	70	93.1	0.9720	12.5	0.9646	2.5	16.0	84.0	0.9657
4	60	92.8	0.9715	18.8	0.9657	1.3	10.3	89.7	0.9663
5	50	92.2	(b)	24.4	0.9657	0.6	5.7	94.3	.....
6	40	93.0	(b)	28.2	0.9658	0.2	2.2	97.8	.....

(a) Assuming weight additivity — average of 4 — 0.9658.
(b) Insufficient material.

TABLE 7—Comparison of Quantities of Extract and Raffinate Oils from Various Stocks at 50-52° F.

Stock	Solvent Ratio—1/1 % Extract Oil	Solvent Ratio—1/1 % Raffinate Oil	Solvent Ratio—9/1 % Extract Oil	Solvent Ratio—9/1 % Raffinate Oil
Gulf Coast Naphthenic, TA-1023	2.2	97.8	43.7	56.3
East Texas, TA-1024	2.5	97.5	40.3	59.7
East Central Texas, TA-1025	9.4	90.6	58.4	41.6
Florida Residuum, S-13	11.8	88.2	90.0	10.0
South Texas Heavy, TA-1026	22.0	77.0	95.0	5.0

and brittle, with much higher softening points than the original base stock. In some cases it is impossible to melt the material without decomposition which prevented experimental determination of the densities in certain runs.

In order to explain the peculiar behavior exhibited by butanol-asphalt systems some speculation is required regarding the composition of the extract oils and raffinate oils. As a matter of fact, knowledge of the composition of asphaltic materials rests almost entirely on separating them into their component parts by means of selective solvent action. Asphalt may be considered as a colloidal system whose components vary from low molecular weight oils to high molecular weight solids, any or all of which may be complex saturated or unsaturated hydrocarbons containing minor amounts of other elements through bridge, ring or other structures. This conglomerate mixture can be considered to be held together in a stable, more or less homogeneous, condition through mutual solubility or interfacial tension effects of the lower molecular weight materials on the next higher molecular weight components present. The addition of a foreign material which exerts a selective solution effect for some of the components present destroys the original colloidal condition of asphalt, thereby precipitating certain portions. It is obvious that the result depends on the solvent, its amount, the temperature and the original asphaltic material. It follows that this precipitation can be controlled for a desired end result by the development and use of solubility curves such as described in this paper.

As has been shown, butanol produces a raffinate containing the higher molecular weight materials and an extract which contains the oily portions. This is the reverse of most treatment of petroleum oils where the raffinate oily portion (more paraffinic fraction) is the desired product. The rejection of the higher molecular weight material by butanol might be explained, as suggested in part by Thompson[9], as the normal rejection of the higher molecular weight paraffinic materials (i.e., ring compounds with long paraffinic side chains) as well as disruption of the interfacial tension forces noted above resulting in precipitation of certain components originally present in the asphaltic material.

While the above may explain in a general way the results obtained when treating asphalt with butanol, it is necessary to account for the fact that some curves indicate that the solvent free extract oil goes through a minimum density while at the same time the raffinate oil increases in density. One line of reasoning that might apply is as follows:

(a) At low concentrations of butanol, the solvent extracts both the low and intermediate molecular weight aromatic or cyclic materials (they would be expected to have high solubilities and the concentrated extract phase might act as a better solvent than butanol alone), but rejects the paraffinics of both high and low molecular weight (because of the low butanol concentration), as well as the high molecular weight aromatic or naphthenic materials.

(b) If higher concentrations of butanol are used, a dilution effect occurs causing some of the intermediate molecular weight resinous material, previously soluble in the extract phase, to be rejected to the raffinate. At the same time at this higher dilution, the butanol tends to dissolve some of the lower molecular weight paraffinic materials that were previously in the raffinate. This reasoning would explain the rise in density of the raffinate oil and lowering of density of the extract oil.

(c) At still greater dilutions (higher butanol concentrations), the solvent tends to extract more of the higher molecular weight paraffinic and aromatic material so that the density of the extract oil rises again; at the same time only the very high molecular weight material is left in the raffinate oil and its density also rises. However, under the conditions of (c) and the transition from (b) to (c) at certain temperatures it is apparent that the solubility relations become very complex. The precipitation from one phase and redissolving in the second phase of the intermediate molecular weight compounds (resinous material) might be considered to be a function of the temperature. At relatively high temperatures the gradual increase of solvent concentration produces no unexpected results. At lower temperatures, the solubility of the intermediate molecular weight material in either phase may be reduced to the extent that it appears as a brownish colloidal suspension thereby producing a three phase system at the conditions shown by the break of the extract curves in Figs. 2 and 3. Or, the density of this intermediate material may be essentially the same as the extract precluding separation by sedimentation. This region would be an interesting field for investigation.

The effect of temperature on the raffinate oils obtained is more readily interpreted. As the temperature is increased, selectivity is generally increased (based on raffinate considerations) because more of the intermediate and higher molecular weight material goes into the extract yielding a raffinate oil of relatively high density compared to extractions at lower temperatures. The absence of this intermediate molecular weight material in the raffinate oil reduces the solubility of the butanol in the raffinate at high solvent ratios. The result is that the isotherms cross with the region of cross-over appearing at the solvent ratios where peculiarities are found for the extracts. A further complication of these systems (evidenced by the Gulf Coast Naphthenic residuum) is that the composition and viscosity of the charge stock may be such as to permit normal selective action of the solvent for aromatic or cyclic materials with rejection of lower density materials to the raffinate at low solvent ratios.

The results obtained in these small-scale experiments may be considered of a preliminary nature to establish phase relationships and the range of conditions which might be selected for larger pilot plant scale studies. The contemplated larger scale studies would be necessary in order to obtain sufficient quantities of the extract and raffinate oils for more exhaustive tests. In this manner the commercial feasibility of butanol extraction can be determined. However, such data are not available at present. On the basis of unpublished data, the yields of oils are expected to be similar to those obtained for propane on the charge stocks, but data are not available for comparing quality of products for the two methods.

Summarizing, the results of this study indicate that asphalt may be fractionated by using normal butanol as a selective solvent, but the relations are rather complex. It is shown that the results obtained are specific with the charge stocks, solvent ratios and temperatures employed, and that anomalous results for the effect of temperatures may be expected.

Acknowledgement

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HYDRAULIC DECOKING*

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Worthington Pump and Machinery Corp.

Hydraulic decoking is the method of disrupting, removing and transporting petroleum coke from vertical coke chambers by means of high pressure water. Practical considerations determine the selection of the method for transporting and collecting the coke after its removal from the coking drums. For a given plant capacity, hydraulic decoking is said to require a smaller number of coking chambers than where other methods of removal are used, due to the faster turnaround time.

PETROLEUM refiners today are vitally interested in producing a minimum of residual fuel and a maximum of gasoline, because of present marketing conditions. As a result, serious consideration is being given to the installation of delayed coking, which eliminates residual fuel, increases gasoline yield, and in addition provides a clean charging stock for catalytic or thermal cracking units.

A large portion of the success of delayed coking can be attributed to the hydraulic method of coke removal. "Hydraulic Decoking" is a method of disrupting, removing, and transporting petroleum coke from vertical coke chambers through the medium of high velocity water. It was devised by the Shell Oil Co. and developed by Worthington Pump and Machinery Corp. and the Allen-Sherman-Hoff Co.

The trend in coking units today is toward greater production, and under consideration at the present time are units with a coke-making capacity as large as 900 tons per 24 hours. The largest capacity unit now in operation has a fresh feed of 15,000 b/d, and produces about 500 tons of coke per day. Because delayed coking is a continuous process, two or more chambers are required, with at least one or more chambers on-stream continuously. Ordinarily, the number of drums varies from 2 to 8, and the diameters of drums range from 10 ft to 17 ft. 6 in. Equipment, however, is available for hydraulic removal of coke from drums having a diameter of 18 ft. Fig. 1 shows a modern, 4-chamber coking unit.

In hydraulic decoking all the coke is removed from the drums by the application of high velocity, high impact water jets. The high pressure water required for these impact jets is supplied to the specially designed decoking tools and nozzles by a high pressure multistage centrifugal pump. These multistage pumps range in capacity from 700 to 1200 GPM, and in pressures from 1000 psi. to 1500 psi., depending on the size of the drums, the quality and quantity of coke to be removed. Generally, it is more economical to use a steam turbine drive in preference to a motor or other prime mover. In the complete cycle of operation of any coking unit the coke temperature is reduced below the flash point by steaming the drums prior to the removal of coke. This steaming usually requires as much, if not more, steam than needed by the jet pump driver.

In preparation for hydraulic decoking a drum is taken off-stream, cooled, and the top and bottom manheads removed. The high pressure jet pump is started and its flow is delivered to the top of the drums. Here the water passes through a swing line with oscillating joints to

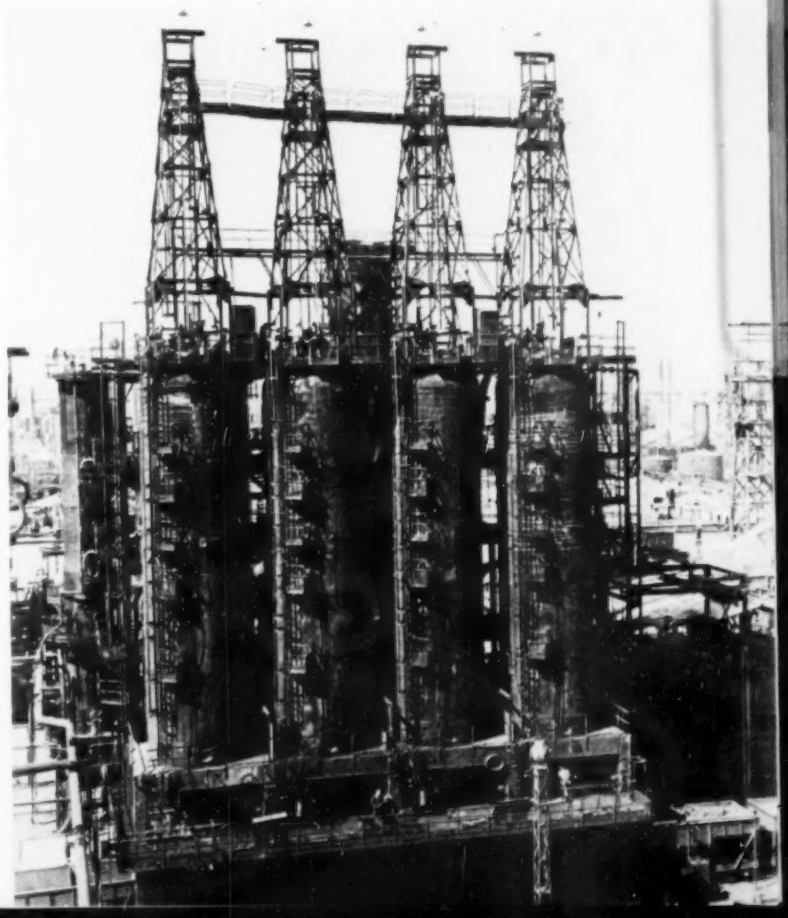

Fig. 1 – A modern four-chamber coking unit

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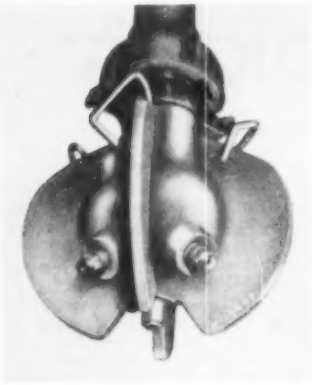
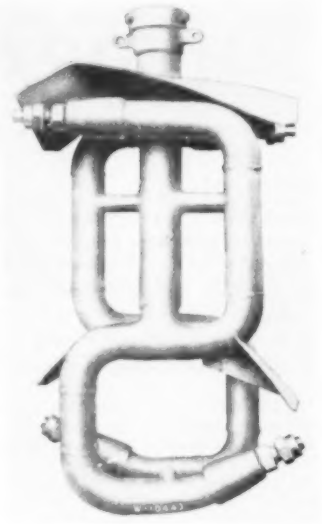


Fig. 2 (left)—Special tool for boring a hole downward through the coke bed

Fig. 3 (right)—Four-jet cutting tool for reaming the coke from the chamber



a swivel from which is suspended a hollow drill stem with a hydraulic cutting tool. The drill stem assembly is supported above the coking chamber by individual derricks mounted over the top of each manhead. The function of the derrick is to allow the various cutting tools to be raised or lowered as required by means of a steel cable and a hoist. The drill stem and cutting tools are made to rotate at a speed ranging from 5 to 15 RPM by an air motor incorporated in the swivel.

3 Steps to Remove Coke

Coke is removed in three steps. The first step is to bore a hole from the top down through the solid bed of coke. This hole is bored as quickly as possible to reduce the amount of water held in the drum. The time for this operation varies from 10 to 30 minutes, depending on the thickness of the coke bed and the character of the coke. Fig. 2 shows the hydraulic boring tool.

The second step is a reaming operation, for which the reaming tool is used. After the boring tool has been replaced by the reaming tool the drill stem is lowered into the drum and a hole is reamed in the coke ranging from 24 to 60 in. in diameter. The size of hole is determined by the width of the final cutting tool, which has to be lowered through this hole into the coke bed.

The final cutting operation is performed in several ways, depending upon whether the operator is interested in minimum coke removal time or obtaining the maximum amount of lump. Another factor which sometimes influences the method of final cutting is the size of the bottom manhead. Where the bottom manhead is relatively small the final cutting operation is usually done from the top down, as this has a tendency to prevent large lumps from wedging in the bottom manhead. Where maximum lump is a consideration, the final cutting tool is lowered to the bottom of the drum, and the coke is removed in layers as the cutting tool is raised in successive steps by the operator. Depending upon the character of the coke and the size of the manhead, these layers are normally from 6 to 12 in. thick. However, where the drums are equipped with large manheads some operators prefer blocking off the lower set of nozzles and making deep scores in the bed with the horizontal nozzles. Starting from the bottom up, these scores are made about 3 ft. apart, and usually result in the cutting out of large lumps.

The cutting tool mentioned above is equipped with four hydraulic jets; two of the streams are projected horizontally, and the two lower nozzles point upward at an angle that allows the horizontal and the angular stream to meet at the chamber wall. The horizontal jets penetrate the coke bed to the chamber wall, whereas the lower jets hit from the underside and tend to break the coke away, cleaning the sidewalls of the chamber as the tool is rotated. Fig. 3 is the final cutting tool.

To save height in the derrick, in some instances a 2-piece drill stem is used, making it necessary to interrupt each operation halfway through the chamber to permit the second length of drill stem to be added or removed between the first length and the swivel joint. Most operators prefer the one-piece drill stem, as this construction saves from 40 minutes to an hour and 20 minutes in a single cleanout.

During normal operation it is necessary to start and stop the water flow to the tool several times. Rather than start and stop the large jet pump prime mover in each instance, provision is made to throttle and divert the discharge from the pump into a bypass line back to the source of supply by means of a hydraulic control valve. This control consists of a main valve and a bypas valve synchronized 180 degrees apart, and operated by a cam mechanism which closes one valve while opening the other. To reduce hydraulic shock which would be caused by the full capacity of the jet pump suddenly reaching the restricted nozzle opening, a time delay device is incorporated in the hydraulic control. This device operates only in the part of the cycle in which the main valve is opened, and it holds the valve in a partially opened position for sufficient length of time to allow the jet pump discharge line and the cutting nozzles to fill at a reduced rate. After water is flowing through the nozzles, the valve stem then raises to the full open position. The control valve is operated by a push button located at the derrick floor; however, other stations can be installed for emergency operation.

3 Basic Moving Systems

There are three basic coke transportation and collection systems — namely, railroad car, hydrobin, and coke pile. Sometimes a combination is used. With the railroad car collection system, a gondola is placed under the coke drum and the coke and cutting water drop into the railroad car. Normally, there are perforations in the sidewall of the car, allowing the water to escape. The water and some coke fines spill into a sump, and are pumped away to a settling pond or clarifier, where the coke fines are removed from the water. Where a clarifier is used the coke fines in the form of a slurry are pumped back over the coke in a gondola which has been filled, and the clear water is returned to the jet pump surge tank. As the gondolas are filled they are replaced by other cars and hauled to the coke pile, where the coke is dumped or unloaded

by clamshell. Fig. 4 is a diagram illustrating the three coke transportation and collection systems for a 4-chamber coking installation.

Water used to cut coke is not suitable for discharge into sewers until the fines have been allowed to settle, as otherwise there is danger of plugging up the sewer.

What Determines Selection

The coke pile system is used where the demand for coke is seasonal, and it is necessary to have considerable storage. A system of this type has an advantage in that the coke pile can be used to filter and reclaim the water used in cutting and transporting the coke.

In the coke pile system the coke and cutting water drop from the coke drum into a rail-mounted portable feeder and sizing car which reduces large lumps to the maximum size suitable for pumping. This car also regulates the flow to the sump to prevent the concentration of coke getting too high and thereby plugging the pump or line. As the coke falls from the feeder car sizing rolls into the sluice it is conveyed to the sump by the cutting water, and also by a stream entering at the top of the sluice. Installed in a dry pit adjoining the coke and water sump at the end of the sluice is a Hydroseal coke pump which pumps the mixture of coke and water to the coke pile usually located several hundred feet away from the chambers. Normally, the discharge of the coke transfer line is directed into a cavity in the pile, thus making certain that the water will filter through the coke pile before entering the catch basin, where it is returned to the system.

If immediate shipping of the coke by trucks or railroad cars is desired, a hydrobin system may be installed. A hydrobin, (Fig. 5) is a large elevated storage bin of conical construction, which separates a major portion of the moisture from the coke, making it suitable for immediate hauling. Classification of the coke as to size can be made by the installation of screens on top of the hydrobin.

Another type handling system pumps the coke and water on to a vibrating screen which separates most of the water from the coke. From the screen the coke goes to a conveyor belt and out to a loading rack or pile. The water and fines coming from the vibrating screen are discharged into a clarifier, which separates the fines from the water. The fines are pumped back to the conveyor system, and the clear water to the jet pump surge tank.

Delayed Coking Processes

Hydraulic decoking installations have been used in connection with either the Dubbs or Gasoline Products delayed coking processes. The Dubbs system usually introduces the hot oil into the top of the chamber, and the heavy fractions fall to the bottom, while the vapors escape through another opening in the top of the chamber. In contrast, the Gasoline Products process usually introduces the hot oil at the bottom of the chamber, and the vapors also pass out at the top. Experience has indicated that the introduction of the vapors into the bottom of the chamber makes a harder coke which is more difficult to remove. Often there is a very dense ledge above the inlet. Although this ledge may contain less than 10% of the chamber volume, it may require more than 50% of the total

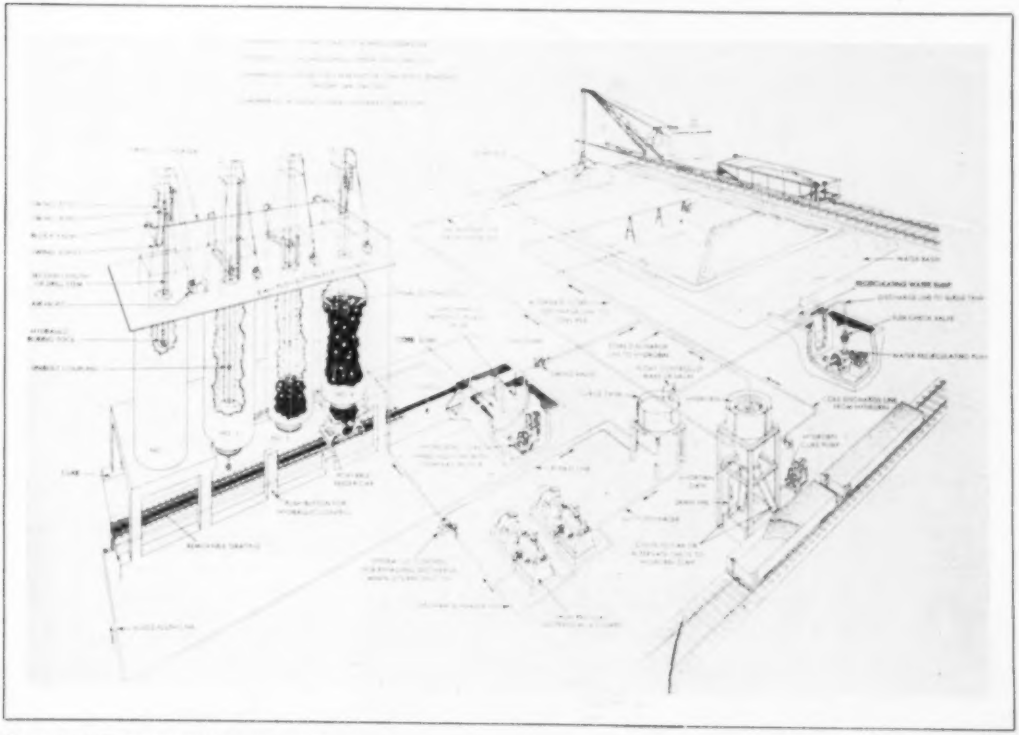


Fig. 4—General arrangement of a hydraulic decoking system for four coking chambers, also illustrating methods for coke transportation and collection

time for its removal, due to its extreme density and hardness.

Originally, the percentage of volatile combustible matter (V.C.M.) was considered to be the sole measure of time required for the removal of coke. Experience proved that V.C.M. by itself was not a true indication of the amount of time required to remove coke, and that porosity was an important factor.

The majority of hydraulic decoking installations have been made on new coking units. However, where direct comparison could be made with other types of coke removal, it has shown decided advantages. As an example, on a unit consisting of one furnace with four drums, where the cable method had been used, the drums were the bottleneck. Hydraulic decoking improved the chamber turnaround time so much that a duplicate furnace and two additional chambers were added, so that each furnace was served by three chambers. Not only were the three chambers sufficient to handle each furnace, but the furnaces turned out to be the limiting factor. Furthermore, the installation of hydraulic decoking in this refinery reduced the cleanout time by 50%, and at the same time allowed a reduction of 45% in the men required in the cleanout crew. The most important saving was made by eliminating the cost of cable, cable clamps, cable hooks, fastening wire, etc., required by the cable method.

Usually the decoking systems are designed so that the time required for the removal of coke is somewhat less than one shift. On large drums, however, this is not always economical. Drum cleanout times, depending on the size of drum and type of coke, range from an average of 3 to 11 hours.

Cable Decoking Method

Prior to the development of the art of hydraulic decoking, the cable method of coke removal was most common. The empty coke drums were laced from top to bottom with a coil of steel cable suspended on light wires prior to being put on-stream. To remove the coke, a winch was attached to the cable after the chamber had been filled and the heads removed. Pulling the cable broke up the coke bed, but this involved the constant danger of cable breakage, resulting in injuries to employes and delays in attaching the cable to the winch. At times the delays attendant to this system forced the shutdown of the unit. Furthermore, the cable had a tendency to swell, which, combined with breakage, caused frequent replacements. The final cleanout had to be made by lowering men into the drum to remove the remaining coke by hand. This was a hazardous procedure, and resulted in serious accidents.

Hydraulic decoking has many advantages, the major ones being economy, safety, cleanliness, and a more marketable product. For a given plant capacity hydraulic decoking requires a smaller number of chambers, due to the faster turnaround time and less men are required. Because it is not necessary for men to enter the chambers, the accident hazard is greatly reduced. The coke is not contaminated by foreign material such as pieces of wire or cable. Maximum capacity is assured because all of the coke is removed from the drums.

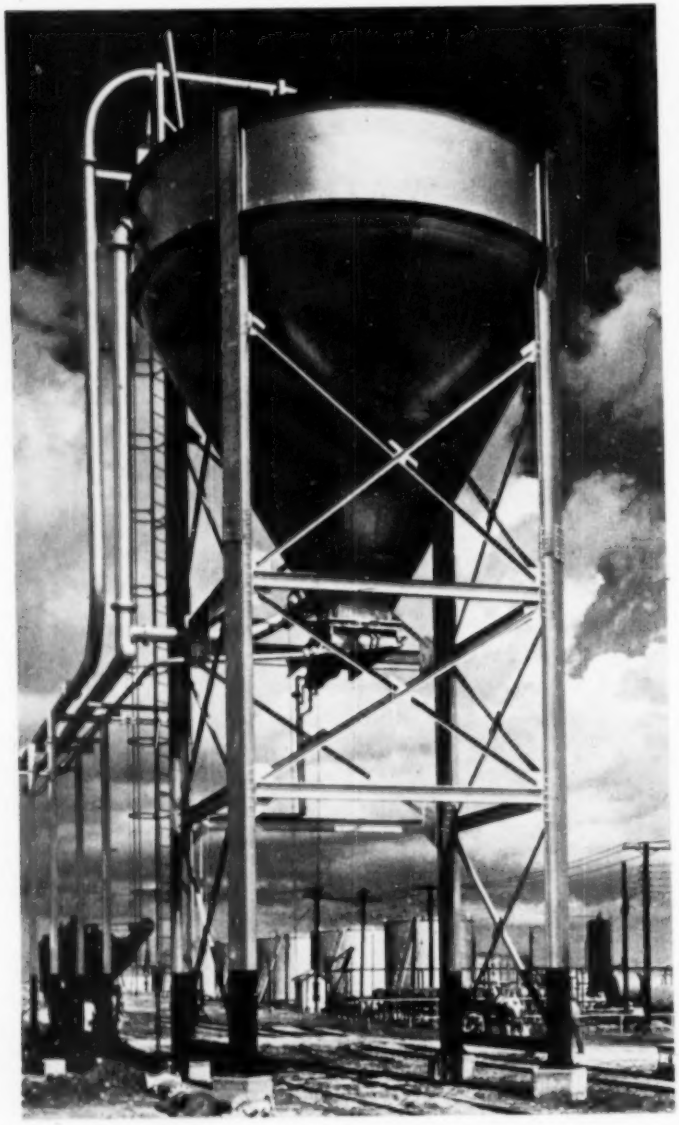
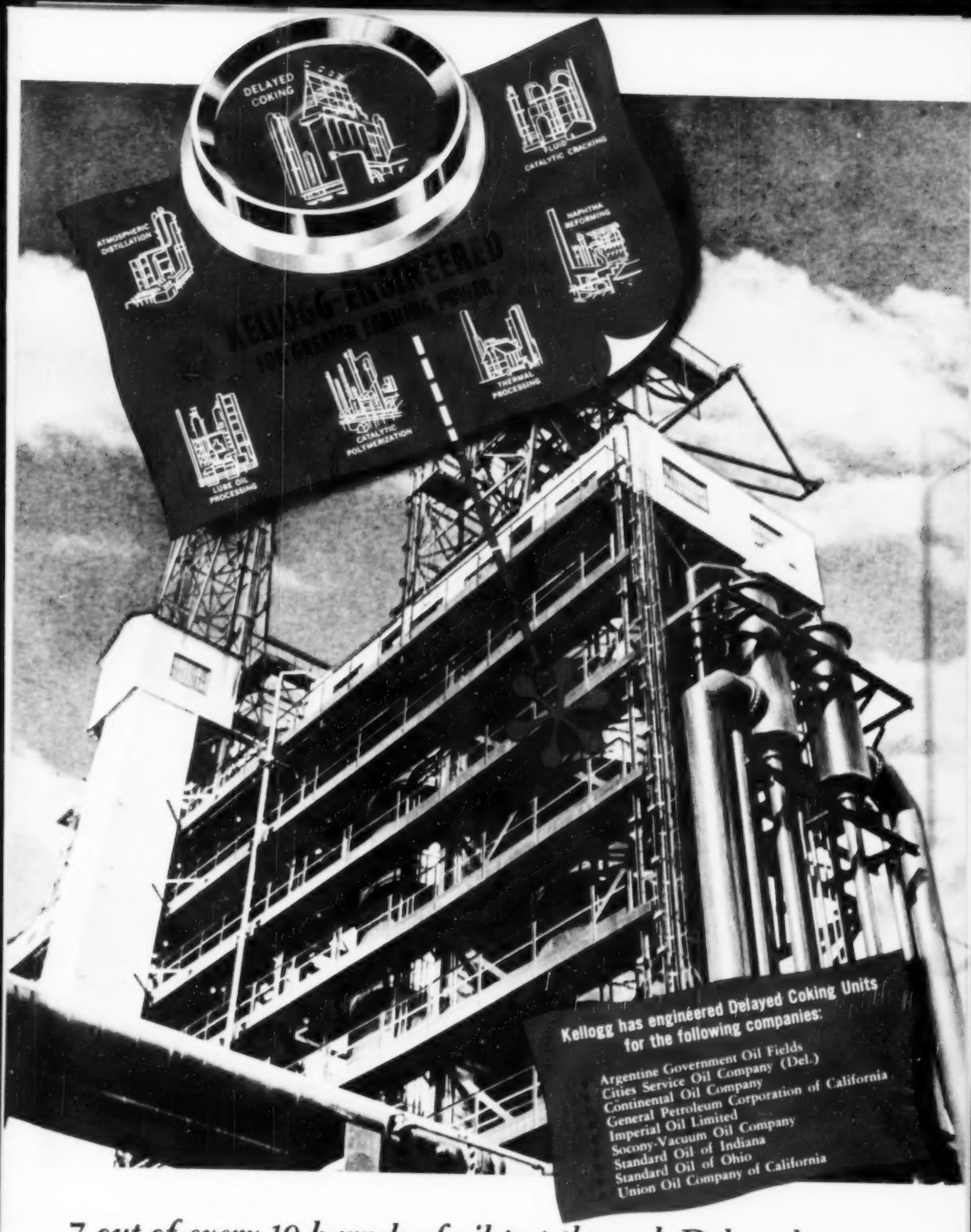


Fig. 5—Hydrobin used where coke is to be shipped immediately by truck or railroad car, instead of stored for future delivery. It consists of a large elevated storage bin of conical construction, designed to separate a major portion of the water content of the coke. Screens may be installed on top of the hydrobin for classifying the coke as to size



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The only question remaining is, "*Who* will build the necessary Delayed Coking capacity?"

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FURNACE DEVELOPMENT IS KEY TO SUCCESS OF KELLOGG UNITS

Today's Delayed Coking is essentially founded upon the efficiency of the furnace itself. Here, the charge stock must be heated to the necessary temperature quickly and then rapidly moved into the coker drums before it "cokes up" the furnace tubes. Thus it is obvious that furnace design is directly responsible for the length of on-stream runs.

It isn't surprising, then, that Kellogg, which has been intimately associated with thermal cracking since its earliest days in the 1920's, and has built literally hundreds of thermal units, should now be designing Delayed Coking units whose runs are exceeding *eight months*. Even then, inspections have shown that units *might have been kept on stream for longer periods without appreciable loss of efficiency.*

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Plant Practices

Practical Tips and Ideas for Improving Operations

Sensitive Meter Locates "Lost" Ground In Three-phase Circuit in Day or Two

THE problem of finding a "lost" ground in a three-phase electrical power system often is tedious and time-consuming. In a refinery, it is imperative that such leaks be located as quickly as possible, particularly for safety reasons.

A method worked out by instrument engineer T. L. Clift of the Latonia, Ky., refinery of Sohio Petroleum Co. has been utilized satisfactorily for some time now in solving this problem. Leaks can be found in a day or two with the method, where formerly as long a period as two months, in some instances, was required.

Ordinarily, voltage readings on each of the three phases of the power line will be substantially equal. A drop in the reading on any one phase generally will indicate that a leak has occurred; however, it will not tell where the leak is located. Suppose, for example, that normal readings are in the range 250-275 volts. A leak shows up by a drop in the reading on that phase to say about 35 volts.

As practiced at Latonia, an inspector then takes a sensitive voltmeter with a range of about 0.1 to 50 volts and patrols the low voltage phase line, making sure of a positive ground at each reading. As he approaches the location of the leak, his voltmeter reading will drop decisively to about 0.1 to 0.5 volts. Where the three-phase system is relatively complex, the Sohio method will at least narrow the search down to a particular processing unit. Then it is a comparatively simple matter to find the leak itself by physical inspection of the electrical equipment on the unit.

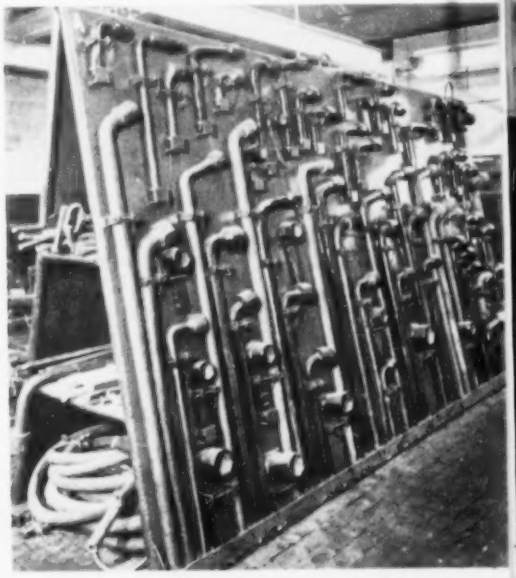
Racks Improve Toolroom Housekeeping In Gulf's Cincinnati Maintenance Shops

GOOD housekeeping in Gulf Refining Co.'s toolroom at the Cleves, Ohio, refinery is a relatively simple job now with the installation of a home-made rack and a set of dollies for handling the various kinds of maintenance tools, as shown in the accompanying photographs.

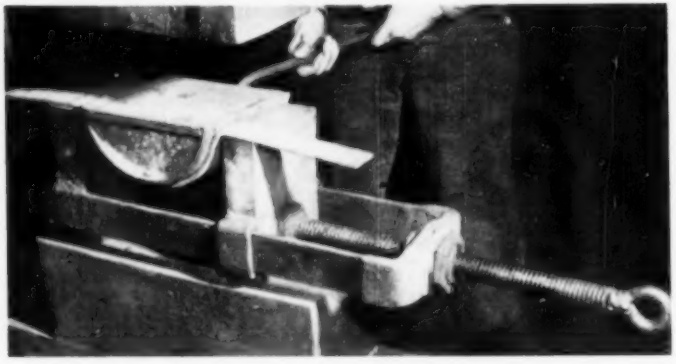
One side of the rack holds chain wrenches; the other side holds socket wrenches. The dollies provide storage on the toolroom floor for chain falls, and at the same time serve as an easy means for transporting the equipment to jobs in the field.

The all-welded rack comprises several narrow A-frames of 1-in. pipe, set up vertically and tied together with a few horizontal lengths of 1-in. pipe, and then covered on two sides with steel plate. Suitable holding brackets designed for the various wrenches are welded to the plate. The lower ends of the wrenches fit into tiny "bins" running along the bottom edge on each side of the rack. Space inside the rack contains shelves for storing miscellaneous items—hose, pry bars, hooks, and the like.

Below left: chain hoist dollies and the chain wrench side of toolroom rack at Gulf's Cleves refinery. Right: socket wrench side of rack



Adjustable Lower Die Raises Speed Of Press for Making Pipe Hangers



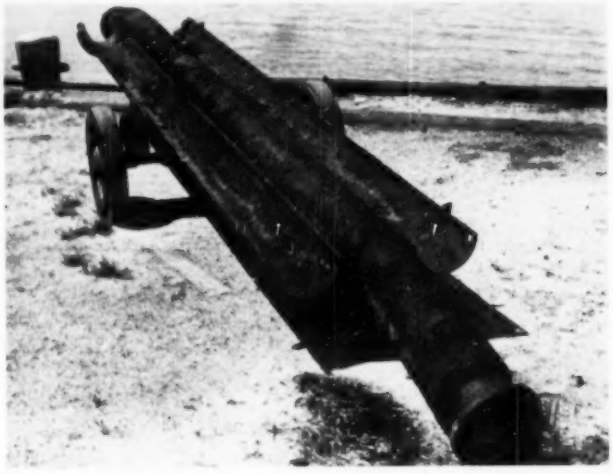
Tide Water Associated's method of fabricating pipe hangers

IN usual practice, pipe hangers are formed of strips of flat iron by bending the hot metal between two dies in a press or under a hammer to the shape required by the pipe on which the hangers are to be used. Because of the many different sizes of pipe and the large variety of sizes of flat iron specified, the blacksmith at Tide Water Associated Oil Co.'s refinery at Bayonne, New Jersey, had to keep on hand a huge number of dies.

By using an adjustable lower die and retaining the upper dies, he has been able to discard the space consuming stock of about 150 solid, lower dies and at the same time speed up work in turning out pipe hangers. As shown in the photograph, the adjustable lower die, of simple and sturdy construction, is being employed under a steam hammer. It comprises a stationary block at the one end, to which is welded the yoke, its position being altered as desired by means of the long, threaded bar.

The strap iron bends to follow the outline of the upper die, so only a skeleton-formed lower die is actually needed. The distance between the two jaws of the lower die is changed quickly to suit the upper die and the thickness of the material being formed. Two sizes of the adjustable die handle the entire range of pipe size requirements encountered at Bayonne.

Handy Cart for Heavy Cargo Hose



Handling heavy links of 4 to 10-in. diameter dock side type loading hose is at best a rugged job—both for personnel and on the hose. A great percentage of cargo hose failures are caused by oil and grit erosion of the outer surface of the hose. A simple dolly built and used at Socony-Vacuum Oil Co.'s Paulsboro, N. J., refinery has provided a solution to this problem. It is fabricated from a second-hand automobile front axle and wheels with three, half-round, 12-in. diameter pipe sections as cradles.

Use Discarded Drill Press For Gate Valve Repairs

Esso's valve repair tool

REPAIRS on gate valves—particularly in the grinding and polishing of gates, seats, and flanges—has been improved in ease of handling at the Bayway refinery of Esso Standard Oil Co. by using an old drill press that has been discarded many years ago by the machine shop. The apparatus and procedure are shown in the accompanying photograph.

Gate valves up to 16-in. size can be handled in a variety of cast brass jigs similar to the one shown, holding a 4-in. gate on the drill press bed plate. The drill has been rigged with a simple chuck to hold emery paper, glued to a disc which revolves against the face of the gate.

Usual procedure is to start grinding with about a No. 20 paper, then follow with No. 2 for finish grinding. Final polishing is accomplished with No. 1 paper plus oil.

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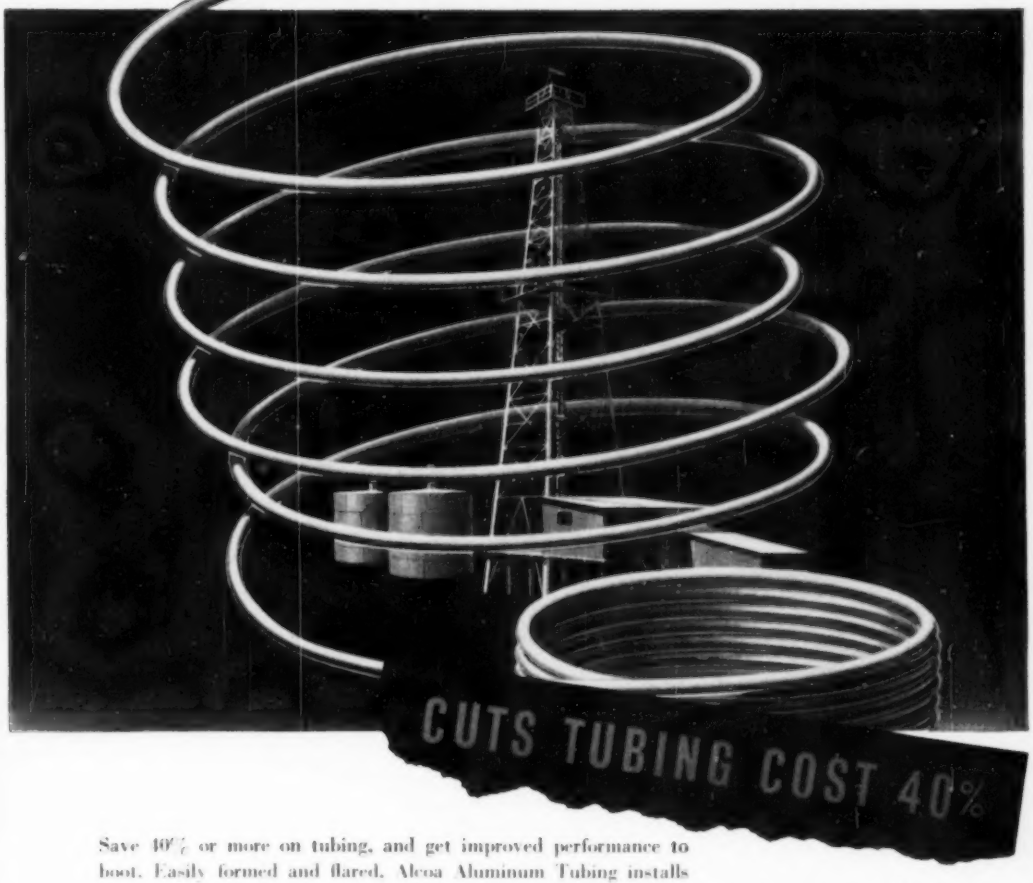

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The Construction and Operation Of a Pilot-size Continuous Still

By C. C. WARD and F. G. SCHWARTZ

Bureau of Mines Petroleum Experiment Station, Bartlesville, Okla.

A continuous distillation unit of pilot plant size has been constructed with a minimum number of controls and requiring little attention during operation. It can be operated at either atmospheric or reduced pressure. Distillation curves on the overhead and bottoms products indicate little overlap in boiling ranges.

Designed for the evaluation of straightrun naphthas, it will handle crude oil at 5 to 6 gals./hr. and has eliminated the need for large batch stills—as high as 100 gal. capacity—normally required to obtain the many narrow boiling fractions utilized in running evaluation tests.

IN 1940 the Bureau of Mines started a study of the composition and ignition characteristics of straight-run naphthas. Each naphtha was prepared by distilling 5 to 10 gals. of crude oil from a selected field in a batch still. As the study progressed it was found that more tests on very narrow boiling fractions were required to better evaluate the naphtha, thus necessitating a considerable increase in the size and number of fractions, and therefore in the total charge. Batch stills of 20, 40, 55, and finally 100 gals. capacity were constructed to meet these requirements. When these stills were found to be too small the assistance of refiners was asked in supplying naphtha cuts from selected crude oils and these cuts were processed in our stills. Although refiners were cooperative in supplying naphthas, the advantage of having a complete processing history of the sample had been lost. In many cases it was difficult to obtain a naphtha from the crude oil selected for study and in some instances material balance data were not complete. In view of these difficulties and because it was planned to make similar studies on Diesel fuel cuts, it was decided to build the continuous still described in this paper.

The still was designed to process 5 to 6 gals. of crude oil per hour at atmospheric pressure to prepare a naphtha cut and to reprocess 3 to 4 gals./hr. of the residue from this distillation at reduced pressure to prepare a gas oil cut.

Description of Apparatus

The continuous still shown in the simplified flow diagram, Fig. 1, can be best described by considering each of its component parts separately.

Feed Tank: Crude oil samples are usually received in 55-gal. drums. Oil is forced by air at 7 psi from these drums to a 12-gal. calibrated feed tank in which the oil level is held constant, except when drums are being changed or the feed rate is being checked.

Charge Pump: The feed-charge pump is an adjustable-stroke reciprocating pump with two opposed cylinders, each of which has a rated capacity of 5.5 gal./hr. One cylinder of the pump delivers crude oil from the feed tank, through the heater, into the column; the other cylinder pumps bottoms product from its accumulator tanks to the bottoms storage drum. Either cylinder of the pump can be set to deliver any rate up to the maximum and each cylinder can be adjusted indepedently of the other.

A relief valve set to open at a pressure of about 75 psi is provided on the line from the pump to the column to void excessive pressure on the line if the pump is started before valves to the column are opened.

Feed Heater: The feed heater is a 26-ft. coil of ⅜-in. O.D. stainless steel tubing suspended within a section of standard 6-in. pipe filled with lead. Heat is supplied by five 900-watt immersion heaters and four 500-watt strip heaters. The four strip heaters are equally spaced around the outside of the 6-in. pipe, and the pipe is covered with about 2 inches of 85% magnesia pipe insulation. The strip heaters were installed after the immersion heaters proved to be insufficient for a 5-gal./hr. feed rate.

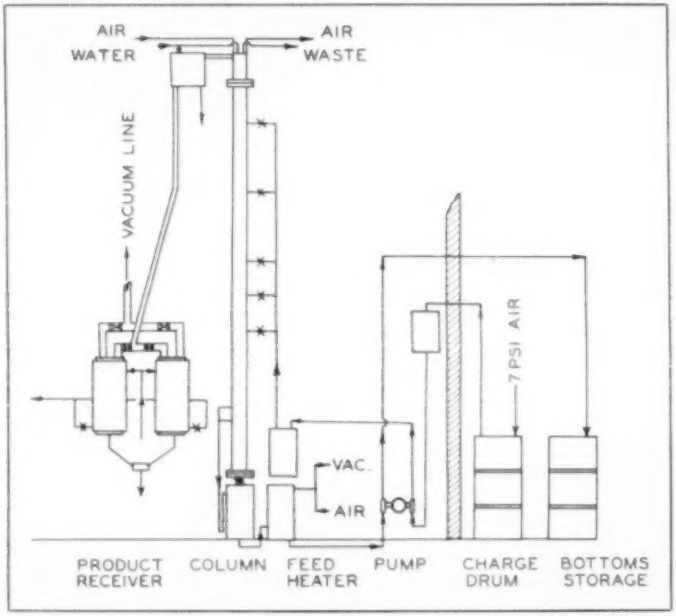


Fig. 1—Flowsheet for Bureau of Mines' continuous pilot still

The heaters, both immersion and strip, are on separate switches, and one 900-watt heater is controlled by a variable transformer. Thus, by proper selection of heaters and adjustment of the variable transformer, the heat input to the feed heater can be varied from 0 to 6500 watts.

Feed Manifold: A manifold is provided to enable introducing the charge into the column at any one of five points, as required by the feed and processing desired. The feed entries are spaced along the column. A thermocouple on the downstream side of the feed heater provides a means of measuring the temperature of the material fed to the column.

Distillation Column: The distillation column is a 13-ft. length of 4-in. extra-strong steel pipe and has three sections—column head, packed section, and reboiler.

The column head has two partial condensers for reflux, a 2-ft. x 12-in. cylindrical, water-cooled condenser and an air-cooled condenser made of 20 ft. of $\frac{3}{8}$-in. copper tubing. The reflux condensers are used to adjust the overhead temperature and the reflux ratio. The water-cooled condenser is used for approximate adjustment of overhead temperature, and final adjustment is made by changing the air flow through the air condenser.

The packed section of the column is 10 ft. long and is packed with $\frac{1}{4}$-in. ceramic Berl saddles. The packing is continuous, with no open spaces, other than the voids normal to the packing. The packing is supported by a conical screen on a ring to which are welded three legs that rest on the bottom flange.

The lower 2-ft. section of the column is used as a reboiler. The reboiler is heated by four 500-watt strip heaters clamped to the outside of the column. A simple overflow maintains a constant level in the reboiler, and the bottoms product overflows into an accumulator below the reboiler. The pressure differential between the reboiler and accumulator is measured with a manometer and these pressures are kept approximately equal by periodically adjusting the accumulator pressure with a small amount of nitrogen.

Kettle Product Accumulators: The kettle product is stored in two accumulators. The first tank receives and stores the overflow from the reboiler; the second tank facilitates removal of product during a vacuum distillation without disturbing the equilibrium of the system.

Total Condenser: A total condenser using either refrigerated or tap water is employed to condense the overhead product.

Overhead Product Receivers: Two water-jacketed receivers are used to collect the overhead product. During atmospheric distillation, refrigerated water is circulated through the jackets and the overhead product is removed periodically into 5-gal. cans and transferred to a storage drum in a room maintained at 38° F.

Operation of the Unit

It usually requires 4 to 8 hrs. to establish the required operating conditions after the unit is started, depending upon how many times the operating conditions must be adjusted to obtain a product having the desired end point. After the proper conditions have been established the unit is operated continuously until the entire sample of crude oil or residuum is processed.

Procedure at Atmospheric Distillation: Several methods were used in trial runs to obtain an overhead product of the desired end point, and the following procedure was found to be the most satisfactory. The desired end point of the product is plotted on the crude oil distillation curve (Fig. 2) and the corresponding volume per cent of overhead product read. After the continuous distillation unit has been brought on stream with the operating variables corresponding approximately to those expected in operation, the charge rate and overhead product rate are measured. The overhead product rate is then adjusted to give the percentage of the charge indicated on the crude oil distillation curve. The unit is allowed to reach equilibrium with that overhead product:charge ratio, and a sample of overhead product is collected for an A.S.T.M. D86 distillation. If the end point is not within ±5° F. of that required, the top temperature or the feed temperature is adjusted to increase or decrease the end point as needed. Another product sample is collected for determining end point, and this procedure is repeated until a product of the desired end point is obtained. When this has been obtained the charge-line manifold is switched to a weighed drum of crude oil, the bottoms accumulator is emptied, and the product receivers are changed.

Vacuum Distillation: The unit is normally operated at 10 mm. of Hg. absolute pressure when separating a gas oil from the topped crude oil. A 12 cu. ft. min. vacuum pump evacuates the system through a 1-in. line connected to the product receivers, and the only pressure control is a manually operated needle valve that is adjusted periodically to maintain the desired pressure.

The procedure used to select operating variables is similar to that used in atmospheric distillation. A routine laboratory distillation at 40 mm. of Hg. is made on the bottoms from the atmospheric distillation, and the point on the distillation curve selected that corresponds to the required end-point temperature of the product. The corresponding volume-per cent of the charge is read from the curve. After the unit is on stream the operating variables are adjusted to give the product:charge ratio indicated by the curve, and subsequent changes are made on the basis of the end point of the product as indicated by an A.S.T.M. D 158 distillation.

Operating Conditions: Temperatures and pressures are read and recorded every 30 minutes, the charge rate is measured every 4 hours, and the specific gravity of each 5-gal. sample of overhead product is mea-

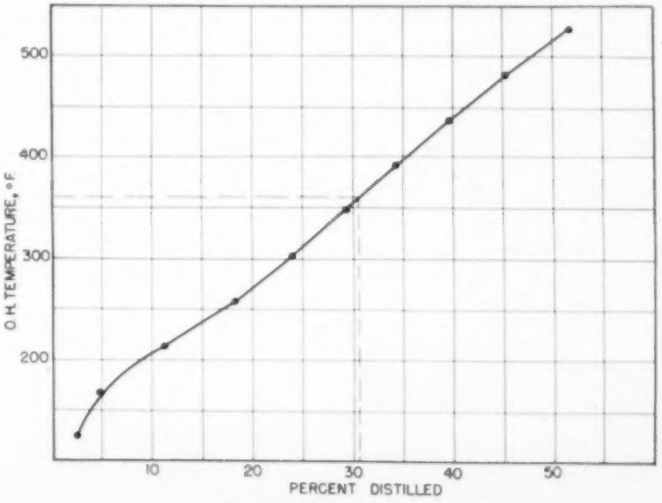
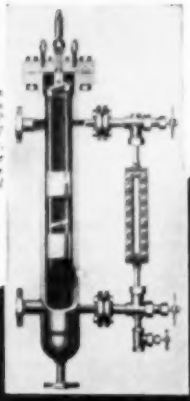


Fig. 2—Hempel distillation curve for crude oil



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sured before it is transferred to the overhead product storage drum. Typical operating conditions at atmospheric and reduced pressures are given in Table 1.

TABLE 1—Operating Conditions

	Atmospheric	Vacuum
Top temperature, °F.	260	355
Top pressure, mm. Hg	745	10
Feed rate, gal./hr.	6.2	3.7
Reboiler temperature, °F.	580	615
Feed temperature, °F.	635	640
Flash temperature, °F.	420	570
Differential pressure, mm. Hg	64	43
Per cent of charge overhead	50.2	64.0

Under these conditions the distillation curves on consecutive fractions indicate little overlap. The separation between the overhead and bottoms products at atmospheric pressure is illustrated in Fig. 3, which shows a gap of 70° F. In Fig. 4 are curves for a gas oil and the corresponding bottoms product; however, these curves are not strictly comparable, as the gas-oil curve is from an A.S.T.M. D 158 distillation and the bottoms product curve is from a Hempel distillation at 40 mm. pressure with temperatures corrected to atmospheric pressure.

Presented before the Division of Petroleum Chemistry at the 15th Midwest Regional Meeting of the American Chemical Society, Kansas City, Mo. Published by permission of the Director, Bureau of Mines, U. S. Department of the Interior.

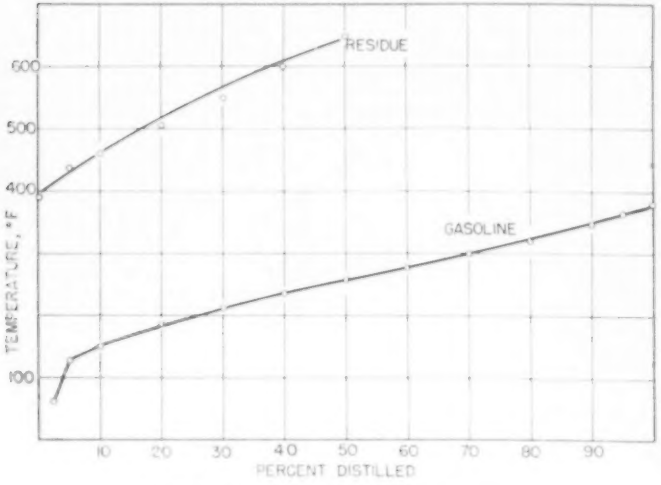

Fig. 3. Distillation at atmospheric pressure

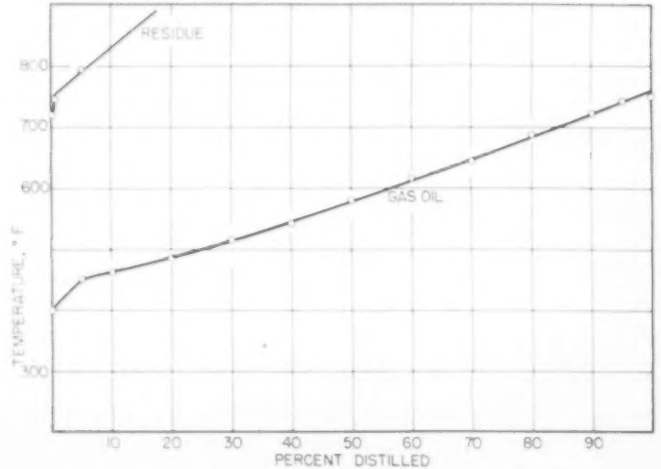

Fig. 4—Reduced pressure distillation (equiv. temp.—760 mm.)

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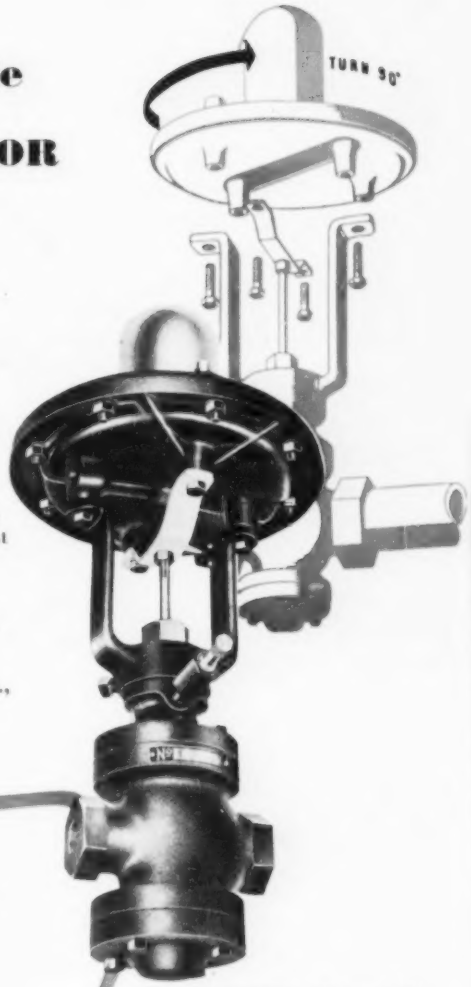

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Diagram A shows air-to-close action of a typical Foxboro valve body equipped with the new reversible motor. Yoke is rigidly attached to diaphragm motor housing and valve stem moves integrally with diaphragm plate. Air pressure is always on the same side of diaphragm whether on an air-to-close or air-to-open action.

Diagram B shows air-to-open action. Here motor has been turned 90 degrees. Now mounting lugs of diaphragm motor housing, originally bolted to yoke, are bolted to valve stem strap and lugs on diaphragm plate are bolted to yoke. Although diaphragm plate is rigidly attached to yoke, the diaphragm is free to move.

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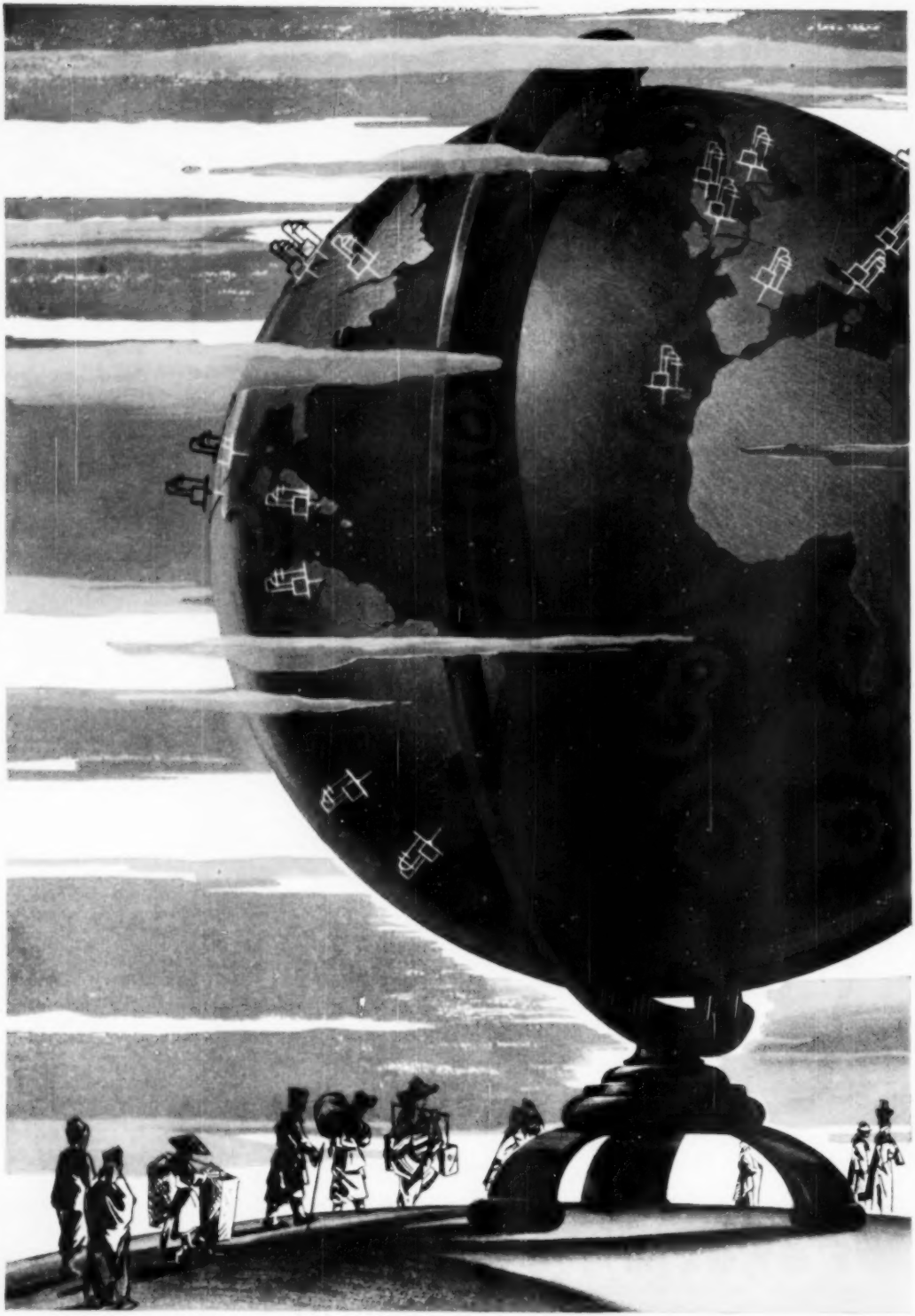

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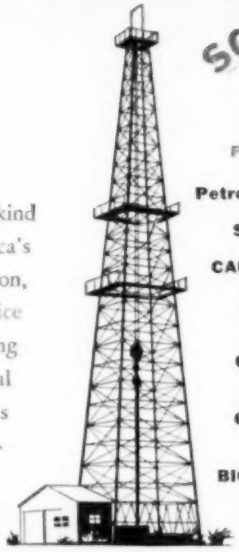

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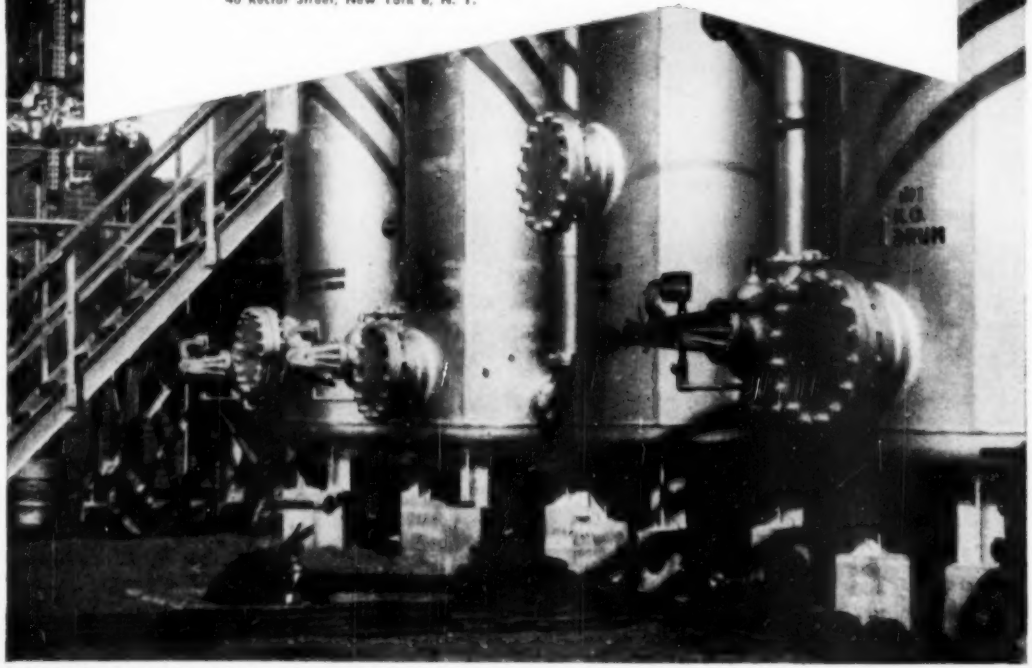

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Patent Trends in Petroleum Refining

By Peter J. Gaylor, Editor "The Technical Survey"

New Desulfurization Method Employs Air Oxidation

ACCORDING to a patent issued to the Pure Oil Co. (U. S. 2,488,000), hydrocarbon liquids can be sweetened by air oxidation in presence of alcoholic solutions of alkali metal alcoholates containing certain types of catalysts. It has been found that solutions of sodium or potassium in an excess of an alcohol (resulting in an alcohol solution of metal alcoholate), are extremely effective agents for conversion of acidic sulfur compounds in the hydrocarbons to innocuous materials when there is present, in the solution, a small amount of phenolic oxidation catalyst, oxidizable to a quinone form. Such a catalyst may be pyrogallol, hydroquinone, n-butyro pyrogallol, anthragallol, gallic acid, tannic acid, hard wood tar, etc.

Small amounts of water do no harm, and in fact help to reduce the solubility of the alcohol in the hydrocarbon, thereby facilitating settling. A ratio of 5 mols of alkali metal to 25 mols of alcohol is preferred in preparing the alcoholate solution.

The oxidation of the sulfur compounds is facilitated by elevated temperature, but, due to recovery complications, excessive elevation of temperature is to be avoided. Ambient atmospheric temperature is most satisfactory.

It is possible to carry out the oxidation reaction directly on the sour naphtha, as in the flowsheet shown in Fig. 1, or on the spent alcoholate treating solution used for scrubbing the naphtha (Fig. 2). In the first case, the sour naphtha 5 and catalysts 20 are run up the tower 3 countercurrent to the stream of alcoholate treating solution 1. Air 7 is continually blown into tower 3 from the bottom to oxidize the mercaptans.

The treated naphtha and air leaving tower 3 through line 8 are run into wash tower 9 into which water 10 is run to remove the alcohol, forming an aqueous solvent solution 14 which is distilled in still 15 to recover alcohol 16 which is run into storage tank 18 and thence into the bottom of tower 3.

The scrubbed naphtha leaving wash tower 9 through line 11 is stored in tank 12.

In Fig. 2, naphtha 31 and catalyst 33 are run into the bottom of tower 30 countercurrent to the alcoholate treating solution 32. Spent treating solution 35 is run into regenerating tower 47 into which air 48 is blown. The regenerated solvent 49 is then drawn off into settling tank 46 from which the disulfide layer (produced by oxidation of the mercaptans) is drawn off through line 50, while the solvent layer is returned via line 51 back into extraction tower 30.

Treated naphtha taken off by line 34 from the top of tower 30 is run into the bottom of scrubber tower 36 while spent air 52 from regenerating tower 47 is run into scrubber tower at a midpoint and water sprays 53 and 37 are employed for scrubbing out solvent which, with the water, is drawn off through line 40 and sent to a still 41 for alcohol recovery.

Washed naphtha is drawn off through line 39 and the exhaust air is bled off at the top of tower 36.

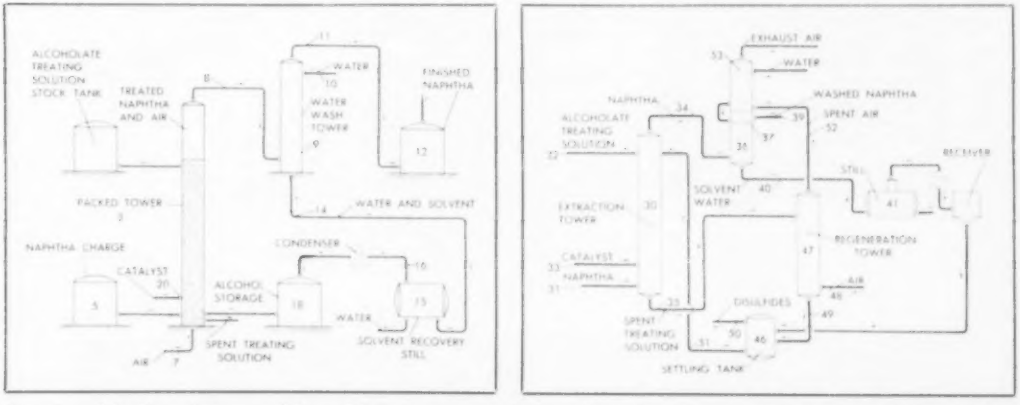
In one example, 15 vols. of sour gasoline containing 0.01% mercaptan were treated with 1 vol. of sodium methoxide-methanol (5 mols Na in 1 liter alcohol plus 15 gms. hardwood tar) by contacting the gasoline with the solution for 15 minutes in presence of air, to produce a doctor sweet product.

Improving Lubricating Oils By Alkylation with Naphthenes

ALKYLATION of low molecular weight hydrocarbons in both the aliphatic and aromatic fields now is well established and common in the petroleum and chemical industries. Although some mention of lubricating oil alkylation has been made in the past, very little data have been submitted on the results obtained.

Recently, a patent issued to Phillips Petroleum Co. (U. S. 2,487,306) disclosed the use of hydrofluoric acid for reacting naphthenes with lubricating oil hydrocarbons, presumably via the alkylation route. Mixed base oils are preferred as raw materials, while monocyclic naphthenes, such as cyclopentane and cyclohexane derivatives, are the preferred reactants, although some bicyclic naphthenes, such as decalin, may be employed.

The process may be more readily understood by referring to the flowsheet illustrated in Fig. 3. Besides



Figs. 1 and 2—Flow diagrams of Pure Oil Co.'s processes for sweetening hydrocarbon liquids. Left (Fig. 1)—Alcoholate-alcohol desulfurization by direct oxidation in the presence of naphtha. Right (Fig. 2)—Alcoholate-alcohol desulfurization by blowing the spent treating solution. (U. S. 2,488,000)

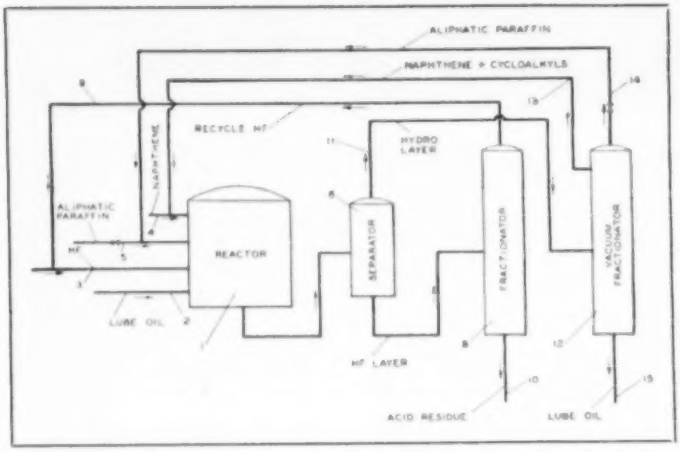


Fig. 3—Flow chart for Phillips Petroleum Co.'s process for alkylating lubricating oils with naphthenes to improve viscosity index (U. S. 2,487,306)

employing a naphthene, it is also preferred to employ with it an isoparaffin such as isobutane, isopentane or isohexane, and this material is fed in through line 5 into the reactor 1. Anhydrous HF is fed in through line 3, while the lubricating oil feed is introduced through line 2, and naphthene hydrocarbon through pipe 4. In the reactor, a temperature of 140°-170° C. is preferably maintained, with pressure sufficient to maintain the acid and hydrocarbons in liquid phase for 110-130 minutes. The amount of naphthene used is about 1.3 to 1.7 times the weight of the oil, while the amount of HF ranges from 1.6 to 2 times the weight of the oil. The proportion of aliphatic paraffin used is about 40-60% of the weight of the total amount of paraffin plus naphthene employed.

After reacting for the period of time specified, the reaction mixture is drawn off into separator 6 from which the hydrocarbon layer is drawn off through top line 11 and fractionated in vacuum fractionator 12, the naphthene and paraffin fractions being recycled through their respective lines 13 and 14.

The bottom acid layer from separator 6 is also fractionated in column 8 and the overhead is recycled via line 9, while some acid residue is drawn off at bottoms 10. Alkylated lubricating oil is drawn off as bottoms 15 from column 12.

Apparently the main advantage of the process is the improvement in viscosity index. Viscosity is generally unaffected or slightly lowered, while stability, pour point and gravity are increased and color is somewhat darkened.

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Patents Issued in December

The following classified listing gives the patent number, patentee or assignee, and a brief description of all patents believed to be of direct interest to the petroleum processing industries, as contained in the Official Gazettes of the U. S. Patent Office for December 6, 13, 20 and 27, Vol. 629, Nos. 1-4.

Fuels

2,490,276 (Standard Oil Development Co.)—Triptane structure compounds.
2,490,606 (Shell Development Co.)—TEL-containing fuel compositions.

Conversions

2,490,287 (Standard Oil Development Co.)—Upgrading of naphtha by hydroforming and thermal reforming.
2,490,336 (Socony-Vacuum Oil Co.)—Powdered catalyst cracking.
2,490,578 (Socony-Vacuum Oil Co.)—Polymerizing olefins.
2,490,774 (Houdry Process Corp.)—Moving bed hydrocarbon conversion system.
2,490,798 (Standard Oil Development Co.)—Powdered catalyst reaction system.
2,490,828 (Houdry Process Corp.)—Apparatus for contacting gases with solid fluent materials.
2,490,853 (Universal Oil Products Co.)—Isomerizing saturated hydrocarbons with $AlCl_3$-$ZnCl_2$ eutectic.
2,490,975 (Phillips Petroleum Co.)—Catalytic conversion with catalyst carrying active material on combustible support.
2,491,099 (Sinclair Refining Co.)—Fluid catalytic cracking reactor.
2,491,135 (Standard Oil Development Co.)—Contacting fluid solids with gases.
2,491,303 (The Texas Co.)—Catalytic cracking.
2,491,407 (M. W. Kellogg Co.)—Catalytic cracking with powdered catalyst.
2,491,446 (Socony-Vacuum Oil Co.)—Distribution of solids to moving compact beds.
2,491,536 (Standard Oil Development Co.)—Gas-solid contacting apparatus including means for stripping solid particles.
2,491,618 (Standard Oil Co.-Ind.)—Catalytic contacting apparatus (H_2SO_4 alkylation).
2,491,752 (Standard Oil Development Co.)—Olefin polymerization apparatus.
2,492,349 (The Texas Co.)—Reactor for fluidized catalyst.
2,492,407 (Lummus Co.)—Catalytic reactor.
2,492,844 (Phillips Petroleum Co.)—Depolymerizing liquid poly-isolefins with iodine.

Refining

2,490,799 (Koppers Co., Inc.)—Regenerating alkali spent with hydrogen sulfide by heating under vacuum with aeration.
2,490,840 (Koppers Co., Inc.)—Gas desulfurization with amine-sulfur forming complex.
2,491,115 (Kincaide)—Solvent extraction.
2,491,786 (Phillips Petroleum Co.)—Recovering isobutene from C_4 mixture.
2,492,473 (Aquanox Corp.)—Demulsifier for water-in-oil petroleum emulsions.
2,492,787 (Lummus Co.)—Solvent extraction.

Chemicals

2,490,257 (Socony-Vacuum Oil Co.)—Mono and polyalkyl mono- and polynuclear mercaptans.
2,490,270 (Socony-Vacuum Oil Co.)—Resins from thiophene and turpentine.
2,490,282 (Shell Development Co.)—Coupling of aromatic hydroxy compounds.
2,490,386 (Shell Development Co.)—Unsaturated acid halides.
2,490,392 (Shell Development Co.)—Hydropyranyl-oxazines, thiazines, oxazolidines and thiazolidines.
2,490,393 (Shell Development Co.)—Hydropyranyl-derivatives of hexahydropyrimidines and imidazolidines.
2,490,813 (Standard Oil Co.—Ohio)—Continuous process for making aryl amines.
2,490,973 (Standard Oil Co.—Ind.)—Catalytic dehydrohalogenation with metal carboxylate.
2,490,984 (Phillips Petroleum Co.)—B-Mercapto thioethers.
2,490,985 (Phillips Petroleum Co.)—Olefin sulfide addition products.
2,491,057 (Atlantic Refining Co.)—Catalytic oxidation of ethylene to ethylene oxide.
2,491,496 (Universal Oil Products Co.)—Synthetic drying oils.
2,491,500 (Standard Oil Development Co.)—Catalytically oxidizing aromatics with free falling fused vanadium oxide spheres and oxygen.
2,491,519 (Standard Oil Development Co.)—Coagulation of Buna N.
2,491,525-6 (Standard Oil Development Co.)—Self-supporting film of styrene-isobutylene copolymer.
2,491,710 (Standard Oil Development Co.)—Nozzle process for making butyl rubber.
2,492,098 (Socony-Vacuum Oil Co.)—Separating methanol from hydrocarbons.
2,492,588 (Phillips Petroleum Co.)—Increasing plasticity of (rubber) dough.
2,492,622-4 & 34 & 44 (Socony-Vacuum Oil Co.)—Halothiophenes.
2,492,629-33 (Socony-Vacuum Oil Co.)—Acylation of thiophenes.
2,492,645 (Socony-Vacuum Oil Co.)—Thiophene carboxylic acid.
2,492,656-62 (Socony-Vacuum Oil Co.)—Metalation of thiophenes.
2,492,663 (Socony-Vacuum Oil Co.)—Halothienyl ethanols.
2,492,693 (Du Pont)—Intercondensation of gaseous monoolefins with alkali metal catalyst.
2,492,927 (Shell Development Co.)—Sulfolanyl ethers and ether-esters.

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Patent Trends

Lubricants

2,490,068 (Continental Oil Co.)—Lubricant containing azelaic diester and silicon compound.
2,490,271 (Sun Oil Co.)—Sulfurized nitriles (oil soluble).
2,491,028 (Standard Oil Development Co.)—Tacky lithium soap grease.
2,491,043 (Atlantic Refining Co.)—Aluminum sulfonate from $AlCl_3$ sludge.
2,491,054 (Standard Oil Development Co.)—Dibasic acid ester grease.
2,491,055 (Standard Oil Development Co.)—Grease containing copolymer stringiness agent.
2,491,222 (Gulf Oil Corp.)—Corrosion inhibitor.
2,491,432 (Shell Development Co.)—Synthetic fluid lubricant.
2,491,441 (Socony-Vacuum Oil Co.)—Water resisting grease containing metal resinate.
2,491,683 (Standard Oil Development Co.)—Lubricant of increased pour stability.
2,491,772 (Standard Oil Development Co.)—Extreme pressure lubricants.
2,491,774 (Schulz)—Penetrating oil.
2,492,534-6 (Universal Oil Products Co.)—Sulfur-containing stabilizers for organic compounds.
2,492,562 (Gulf Research & Development Co.)—Sulfurization of fatty oils.
2,492,780 (Jasco)—Poly butene-polyacrylate thickened lube oil.

Hydrocarbon Synthesis

2,490,283 (Shell Development Co.)—Addition of carbon monoxide-hydrogen to unsaturated compounds.
2,490,463 & 5 (Phillips Petroleum Co.)—Hydrocarbon synthesis and catalyst.
2,491,518 (Hydrocarbon Research)—Generation of synthesis gas.

Specialties

2,490,264 (Standard Oil Development Co.)—Rust preventing composition.
2,490,437 (Phillips Petroleum Co.)—DDT solution.
2,490,444 (Shell Development Co.)—Alkylated aromatic compounds of improved color.
2,490,484 (Phillips Petroleum Co.)—Stabilized DDT solutions.
2,490,744 (Socony-Vacuum Oil Co.)—Antirust agent.
2,491,035 (Standard Oil Development Co.)—Stabilizing soil.
2,491,066 (Standard Oil Development Co.)—Rust inhibitor for mineral oils.
2,491,120 (Standard Oil Co.—Ind.)—Flushing compositions.
2,491,715 (Standard Oil Development Co.)—High density molded articles of cork and elastomer.
2,491,822 (Phillips Petroleum Co.)—Protective covering for electrical conductors.

Catalysts

2,490,260 (Universal Oil Products Co.)—Catalytically inactive inorganic oxide particles.
2,490,993 (M. W. Kellogg Co.)—Catalyst stripping.
2,491,116 (Standard Oil Development Co.)—Friedel-Crafts type catalyst complexes.
2,492,132 (Socony-Vacuum Oil Co.)—Heat-treating and drying particle-form absorbent solids.
2,492,167 (Socony-Vacuum Oil Co.)—Forming alumina-containing gel beads.
2,492,651 (Sun Oil Co.)—Determining maximum catalytic activity of etched metallic catalysts.
2,492,808 (Socony-Vacuum Oil Co.)—Gelling viscous sol particles in aqueous ammonia.

Miscellaneous

2,490,579 (Socony-Vacuum Oil Co.)—DC measuring system.
2,490,787 (Socony-Vacuum Oil Co.)—Oxygen.
2,490,906 (Standard Oil Co.—Ind.)—Oxygen production using metal oxide.

How to Obtain Patents

Readers may obtain copies of any U. S. patent from the Patent Office at 25 cents each. Order by patent number direct from the Commissioner of Patents, Washington 25, D. C.

Catalyst Flow Rate Measured By New Electrical Instrument

In addition to the electrical catalyst flowmeter described below, this month's review of new and improved devices used in petroleum processing and handling operations on which patents have been issued recently includes:

- **Screen type tower packing increases contact efficiency**
- **Protect thermocouple wires against high temperatures**

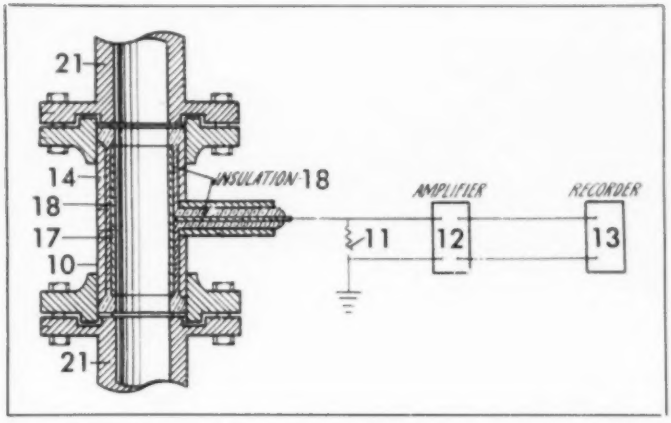

Fig. 1—Electric flowmeter for measuring catalyst flow rates (U. S. 2,491,445)

AN IMPROVED MEANS for measuring catalyst flow rate in a cracking unit utilizes the fact that the solid particles entrained in the fluid flow become electrically charged during their passage through a conduit or pipe.

The instrument, shown schematically in Fig. 1, consists of a collector unit, 10, inserted in a bypass conduit 21 of the main catalyst flow line. It is connected electrically to a suitable measuring device, comprising a grounded resistor 11 coupled to amplifier 12 and recorder 13. As the charged catalyst particles contact the collector element 17, the accumulated charge causes a current to flow which results in a measurable drop in potential that varies with the volume of particles flowing through the conduit.

Unit 10 comprises an insulated section of pipe, including body member 14 and collector element 17, insulated from each other by insulating material 18. The actual flow rate of the catalyst is then obtained by calibrating recorder 13 in such terms as lbs./hr., tons/min. or any units desired. Such calibration must necessarily take into account the weight, size, and composition of the solid particles, the temperature and composition of the transporting fluid, the conduit material, the grounding of the conduit, and the presence of any other factors, such as contaminating materials, steam, etc.

In systems where it is undesirable to insert a metal collector element in the catalyst stream, a variation can be employed. The element can be a metallic shield closely surrounding a conduit of glass or any dielectric material suitable to meet the operating conditions involved.

U. S. 2,491,445, issued December 13, 1949, to James Jay Cunningham, Robert William Beggs Johnston, and Ross Elton Phillips, assignors to Shell Development Co., San Francisco.

Screen Type Tower Packing Increases Contact Efficiency

MAXIMUM EFFECTIVENESS in countercurrent gas and liquid contacting equipment, such as fractionating columns, scrubbers, cooling towers, and the like, can be obtained by careful design of the packing, it is claimed.

Two recent patents—one covering the packing proper and the other covering a distribution device—indicate that maximum contact of the two phases can be obtained when the liquid flow is in a regular, predetermined, symmetrical pattern. This uniformity is assured when the packing elements are in the form of rods, wires, tubes, flat strips, or the like, arranged to form a symmetrical network. The feed liquid is then directed into thin filmiform streams, providing comparatively large surface areas in relation to their cross-sectional areas. Staggering each layer of screen provides still further intermixing of downflowing streams and upflowing gases.

U. S. 2,490,079, and 2,490,080, issued December 6, 1949, to Francis L. Melvill, New York, N. Y.

Protect Thermocouple Wires Against High Temperatures

THERMOCOUPLE WIRES, especially those inside furnaces, require protection against the detrimental effects of high temperatures which tend to cause rapid oxidation of most commercially-available wires.

A method of providing the needed protection is illustrated in Fig. 2. A series of porcelain sleeve protectors 2 are threaded on the wires so as to cover them from their junction 7 at the furnace tube as far up as protection is desired. They are then painted with a thin coat of sodium silicate 3. After this layer has dried to a sticky condition, a wrapping of asbestos

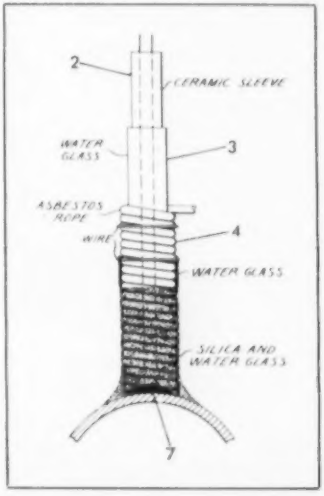

Fig. 2 — Protected thermocouples for use in high temperature furnaces (U. S. 2,491,823)

cord 4 is applied, followed by another coating of sodium silicate and then a coating of a thick slurry of diatomaceous earth and sodium silicate. The entire composition is allowed to dry thoroughly and then is fired to fuse the mass.

Several couples of this design, it is stated, have been used in a furnace for 2747 onstream hours, during which time the furnace was closed down several times.

U. S. 2,491,823, issued December 20, 1949, to Bernard G. Maguire, assignor to Phillips Petroleum Co.

Patents Issued in December

The following classified listing covers patents issued during the month of December believed to be of interest or value to petroleum processing and handling operations:

Catalytic Reactors

2,490,774 (Houdry Process Corp.)—Moving bed hydrocarbon conversion system.
2,490,798 (Std. Oil Development Co.)—Fluid type catalytic reaction unit.
2,490,828 (Houdry Process Corp.)—Apparatus for contacting gases with solid fluent materials.
2,491,099 (Sinclair Refining Co.)—Fluid catalytic reaction chamber design.
2,491,536 (Std. Oil Development Co.)—Catalyst stripper for fluid catalytic cracking units.
2,491,618 (Std. Oil Co., Indiana)—Catalytic contacting chamber for alkylation, isomerization, or polymerization.
2,492,407 (The Lummus Co.)—Catalytic reactor.

Processing, general

2,490,079 (Francis L. Melvill)—Fractionating tower internals.
2,490,080 (Francis L. Melvill)—Fractionating tower internals.
2,490,152 (Thermal Liquids, Inc.)—Still, using tetra-aryl ortho silicate compounds as the heat transfer medium.
2,490,294 (Elliott Co.)—Deaerating heater.
2,491,209 (Gilbert & Barker Mfg. Co.)—Bubble cap assembly.
2,491,726 (Glitsch Engineering Co.)—Tray for use in refining towers.
2,491,752 (Std. Oil Development Co.)—Reaction unit for the continuous polymerization of isomonoolefins or mixtures of isomonoolefins and diolefins by treating with Friedel-Crafts type catalysts at low temperatures.
2,492,409 (The Lummus Co.)—Heat exchanger.

Instruments

2,490,579 (Socony-Vacuum Oil Co., Inc.)—Direct current measuring system.
2,490,792 (Fischer & Porter Co.)—Viscosity-insensitive flow meter of the variable area type.
2,491,445 (Shell Development Co.)—Flowmeter designed particularly for metering catalyst flow rates.
2,491,823 (Phillips Petroleum Co.)—Protective covering for electrical conductors, for thermocouple leads.
2,492,493 (William H. Misson)—Generator and fluid flow meter.

Pumps

2,491,351 (Alexander Zeitlin)—Rotary pump of the sliding vane type.
2,491,352 (Alexander Zeitlin)—Rotary pump of the sliding vane type.
2,492,585 (James P. Johnson)—Reciprocating vane rotary pump.

Tanks

2,490,767 (Chicago Bridge & Iron Co.)—Seal for floating roof tanks.
2,490,829 (Chicago Bridge & Iron Co.)—Sealing means for lifter roof tanks.

Tools

2,490,371 (Raymond P. Norton)—Pipe facing machine.
2,492,491 (Frederick J. McCalla)—Manual pipe bending vise.
2,492,567 (John J. Tipton)—High-pressure pipe patch.
2,492,834 (Helen M. Bayler)—Lever and pawl feed sliding jaw wrench.

Miscellaneous

2,490,189 (William J. Alexander)—Collapsible hand truck.
2,490,194 (General Detroit Corp.)—Operating mechanism for safety can closures.
2,490,328 (Std. Oil Development Co.)—Electrical connecting and sealing device.
2,490,493 (Henry N. Wade)—Attenuation pulsation dampener.
2,490,880 (Black, Sivalls & Bryson, Inc.)—Apparatus for shaping flanges on dished heads.
2,491,073 (Barrett-Cravens Co.)—Pallet skid.
2,492,274 (Edward C. Dempsey)—Automatic shutoff for storage tanks of flow lines.

How to Obtain Patents

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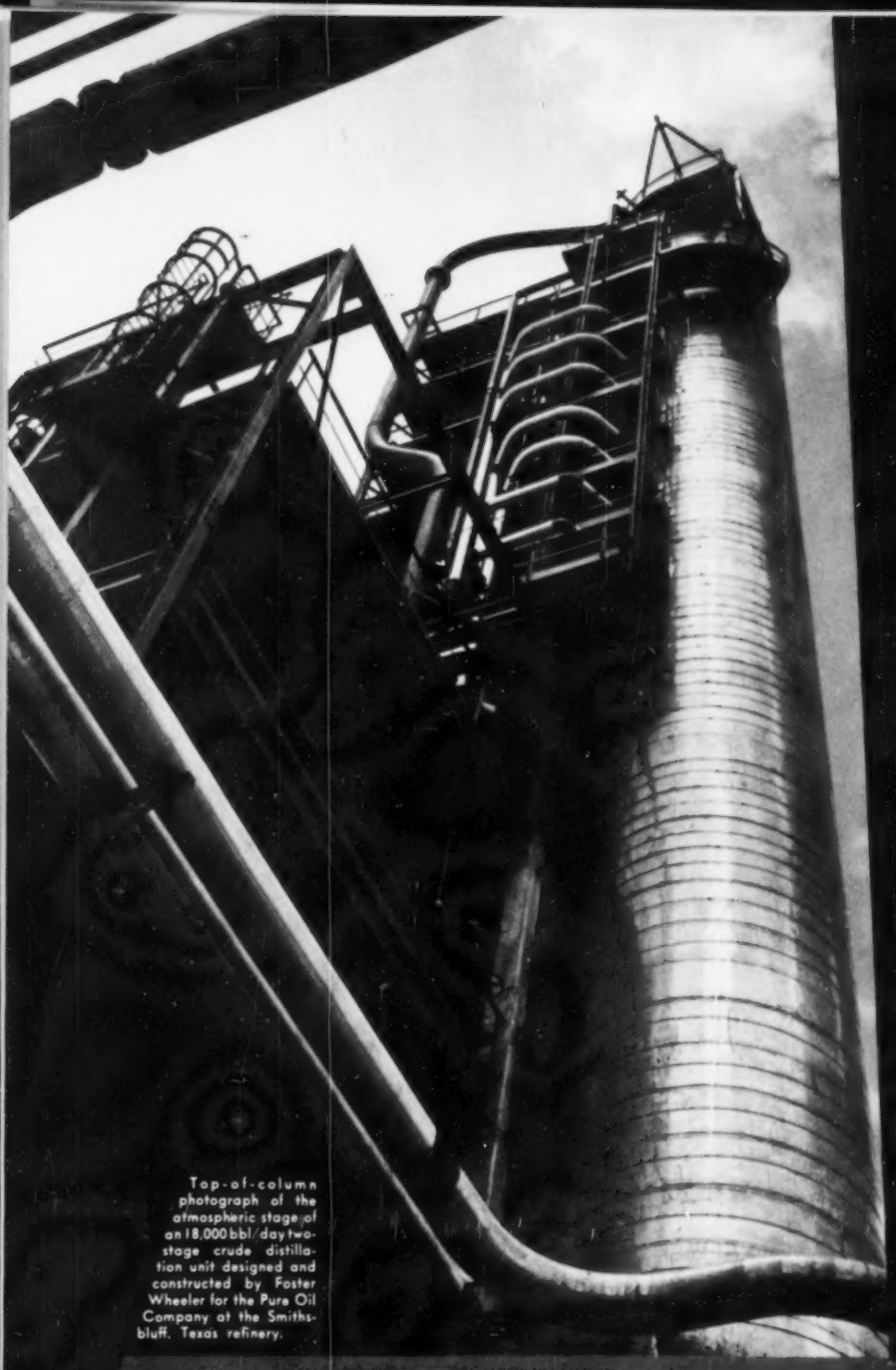

Top-of-column photograph of the atmospheric stage of an 18,000 bbl/day two-stage crude distillation unit designed and constructed by Foster Wheeler for the Pure Oil Company at the Smithsbluff, Texas refinery.

five products

3

gaps

one fraction
no gap — no overlap

Cut	IBP	FBP	Gap
Top	—	248	
			6
2	254	312	
			—
3	312	382	
			12
4	394	532	
			18
5	550	664	

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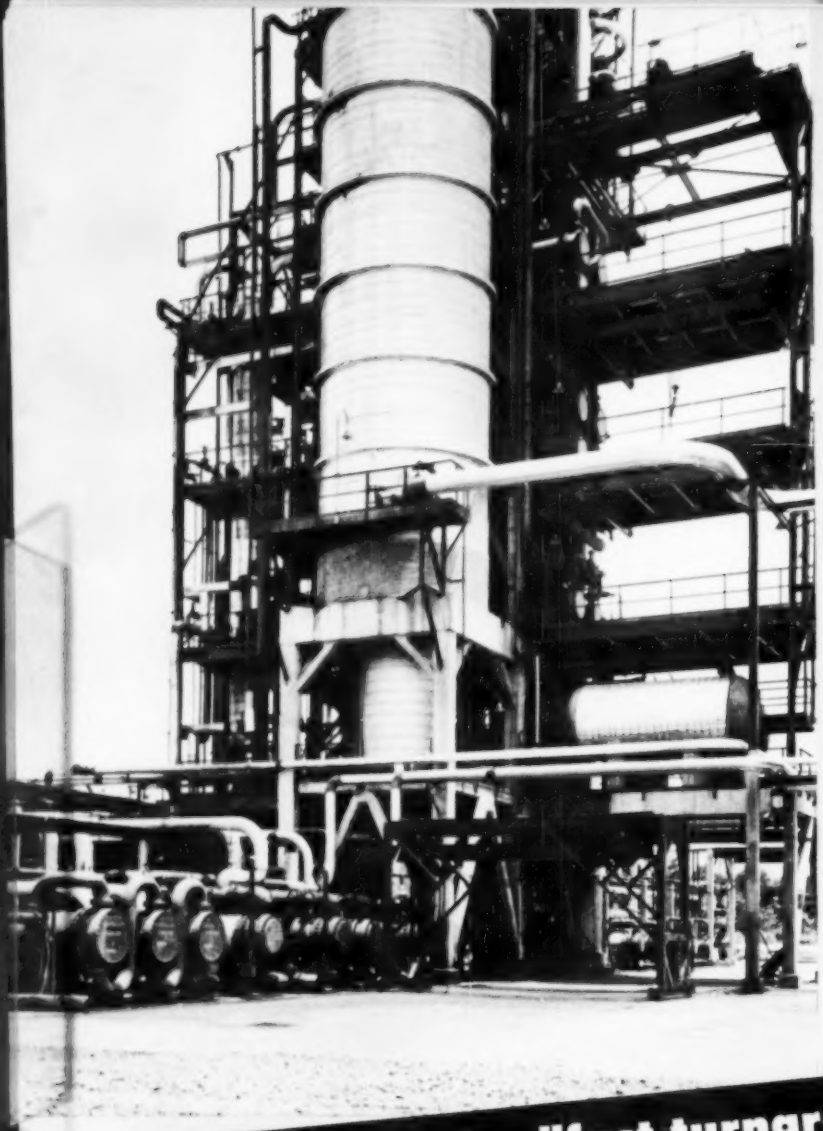

designed for "fast turnaround"

Traveling crane available for removal of any exchanger in the ground level exchanger bank . . . also . . . movable cranes on three roomy column platforms for servicing condensers.

These and other "shutdown features", designed into this crude unit, maintain process equipment at maximum efficiency and contribute effectively to a "fast turnaround" and a high overall operating economy.

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Gasoline and Cycling Plant Operation

Conducted by DAVE THORNTON

The practical data on gasoline plant operating problems presented here this month are taken from papers and discussions during the Panhandle-Plains Regional Meeting of the Natural Gasoline Assn. of America at Amarillo Dec. 9. The questions selected concern problems common to many plant operators, on which the meeting program was based.

As always, questions from readers are invited pertaining to problems of gasoline and cycle plant operations.

Instrumentation for 4-Column Fractionator System

Discuss recommended instrumentation for a four-column fractionating system separating high purity propane, butane and isobutane from raw natural gasoline.

In a system used in an actual plant the raw gasoline is pumped to the depropanizer where propane and ethane are taken as overhead product and subsequently ethane is separated overhead in the de-ethanizer, the bottom product of which is finished propane. The debutanizer charge originates from the base of the depropanizer, taking the butanes overhead and delivering finished gasoline as the bottom product. The butanes are split in the deisobutanizer.

Depropanizer

The raw gasoline make tank must be sufficiently large to absorb all production irregularities. Depropanizer charge is controlled by an averaging type liquid level controller pneumatically setting the control point of a flow controller, the control valve being located in the steam line to the charge pump. This cascaded system is necessary to insure constant feed rate as called for by the level controller and irrespective of pressure variations across the control valve, to thereby avoid variations in the percentage of vaporization of the feed stock.

The flow controller is set to maintain a constant differential and, should operating pressure upstream or downstream of the orifice plate change, the flow controller will immediately reposition the control valve to restore flow to the original value. Had the installation included only a level controller, flow changes consequent upon pressure variations would not have been corrected until the level controller sensed the changes in level and repositioned the control valve.

The temperature control, setting heat input to the reboiler, must have an automatic reset provision to compensate for time lag between an altered reboiler heat input and the resulting effect on the tray where the temperature bulb is located. If reboiler steam supply is not maintained at constant pressure, it will be necessary to have the temperature controller set a flow controller in the steam line to compensate for such changes. Otherwise, should steam supply pressure vary, process upsets will occur before the temperature controller senses the change. The temperature controller bulb should be set on the tray where maximum temperature variations occur, as determined from a temperature gradient curve for the column.

Reflux rate is controlled by a flow controller having the automatic reset function to compensate for time lags, and setting steam supply to the reflux pump. Since the feed is under control it is comparatively simple to set the reflux at the desired ratio. On columns where feed rate is variable, such as by level control from a preceding unit, improvement in reflux ratio constancy could be made by having the level controller on the feed tank also reset the control point of the reflux flow controller.

The reflux on this column is only partially condensed at the reflux drum in order to avoid subcooling. The pressure control therefore is located in the vapor line between reflux accumulator and the final condenser. It is equipped with automatic reset to maintain constant pressure regardless of variations in feed rate or temperature, reflux temperature or ambient temperature.

A proportional-type controller will not maintain constant column pressure if pressure changes up or downstream of the control valve located in the overhead vapor line—as a result of variable feed flow, for instance. If pressure changes, the valve must open or close to maintain constant pressure. But, with this type control, the only way the valve can change is for pressure to change and *stay* changed. When that happens, assuming temperature remains constant, fluid composition on the temperature control tray must change, with the inevitable result that purity of either overhead or bottom product is reduced—i.e., the penalty is poor fractionation.

De-ethanizer

The de-ethanizer feed (depropanizer overhead product) is automatically rate controlled with a level controller setting the control point of a flow controller. The temperature controller has its bulb at the point of maximum temperature differential and sets the control point of a flow controller which, in turn, rate controls exhaust steam to the column reboiler. The bottom product is 98.87% pure propane to storage and the overhead is ethane to plant fuel. Reflux is flow controlled as on the depropanizer and back pressure is held on the reflux drum through a pressure controller.

Debutanizer

Feed to the debutanizer originates from the depropanizer reboiler, the level controller there setting the flow controller. Flow occurs from pressure differential between the columns. Pressure is held on the overhead vapor line and vapors are totally condensed. A column temperature controller controls reboiler steam. Reflux is controlled conventionally. The level control on the reflux drum sets a flow controller supplying deisobutanizer feed since bottoms are controlled vapor pressure natural gasoline.

Deisobutanizer

Reflux control on the deisobutanizer is conventional with a ratio of approximately 13.5 to 1. With practically pure butane bottoms and column pressure constant, additional reboiler heat input will not increase product temperature. Hence placement of the temperature controller bulb (which resets the rate of flow controller on the reboiler steam line) is critical and should be at the point of maximum temperature (and tray fluid composition) change.

However, there is a very serious velocity distance lag and a heat transfer lag between the points of temperature measurement and heat input, hence the temperature controller must have automatic reset and derivative functions to compensate for them. The reset function reposi-

tions the valve at a rate proportional to the measurement deviation from the set control point; corrective action therefore increases as the magnitude and duration of the deviation increases. The derivative function applies a correction proportional to the rate of change of measurement; therefore is entirely indifferent to either amount or duration of deviation. The control valve for the back pressure controller is located in the vapor line between tower and condenser, the vapor being totally condensed. "Control Instrumentation Applied to Light Ends Fractionation" by E. L. Stark, The Foxboro Co., Dallas.

Maintenance and Operation Of Air Cooling Equipment

Please discuss the maintenance and operation of air-cooled exchangers and condensers.

Normally, air-cooled equipment is designed for cooling the fluid to the highest final temperature which can be tolerated for short periods with the highest air temperature expected during these same periods. There are two general types—forced and induced draft—having one or more cells per unit and with one or more fans, usually with adjustable-pitch blades. Drivers may be single or two-speed electric motors, gas engines and turbines.

Varying the air circulation rate not only alters the mean temperature difference but has a marked effect on the heat transfer coefficient; therefore the performance of air-coolers is dependent upon and can be controlled by varying air circulation. When the cooler consists of several cells, each having one or more fans, performance can be regulated by shutting down fans as air temperature drops. Even though the cooler consists of only one or two cells, fairly good control can be obtained with two-speed motors as drivers. However, it often is advisable to use two fans per cell, each driven by two-speed motors. In addition to added control, the second fan assembly permits stopping one fan for maintenance or repair without shutting down the cooler.

Where fans are driven by gas engines or turbines, the fan speed can be varied to give desired performance, but this type of drive should be equipped with governors to prevent overloading fan and gear, and gear horsepower rating should equal that of the driver. Blade pitch likewise can be varied to control the air circulation.

Additional control may be obtained by by-passing a part of the fluid around the cooler, providing it is not undesirable (as in the case of condensers) to by-pass uncondensed vapors. However, in many cases too much cooling is obtained during extremely cold weather, even with all fans shut off and as much fluid being by-passed as feasible without incurring the risk of freezing the balance going through the cooler or forming hydrates. In these instances it is necessary to obstruct the air flow caused from natural draft, by either manually or motor operated shutters.

Operators should bear in mind that fan *horsepower* varies as the cube of the speed, whereas fan *capacity* varies directly with the speed. Theoretically, at half speed 50% of the full load air requirement is handled with 12.5% of the full-load horsepower. Roughly speaking, a jacket water cooler designed on the basis of 100° F air will give desired performance with fans at half speed when the air temperature is around 75° F. With two speed motors or variable speed drivers, fan horsepower can be reduced to a fraction of full-load requirements during a large part of the time.

Operating precautions include protecting tubes against freeze-ups by controlling temperatures, draining the system during shut-downs and the use of anti-freeze solutions. If fans have been out of operation during cold weather, any ice which may have collected should be removed; otherwise they will be out of balance and may vibrate severely, damaging equipment.

Oil in gear cases should be changed periodically and other mechanical equipment lubricated as recommended by the manufacturer. Tubes should be inspected occasionally, cleaned if dirty, or replaced if corroded. "Selection, Operation and Maintenance of Air Cooling Equipment" by M. A. Ellsworth, The Fluor Corp., Ltd., Tulsa.

Automatic Compressor Station Advantages, Disadvantages

What are the advantages and disadvantages of automatic compressor stations and the maximum size suggested for a single installation?

For the purpose of this discussion an "automatic compressor station" does not imply that it be 100% automatic, but does require that it be capable of continuing in operation under anticipated load changes for at least 24 hrs. in the absence of operating personnel.

The best reason for designing an unattended compressor station is the financial saving in operating costs. The minimum cost of maintaining operating personnel at a station on a 24-hr. basis is of the order of $12,000 per year at present labor rates, and this represents the maximum payroll saving which might conceivably be achieved. In practice it is impossible to save all personnel expense, since some maintenance must be done during the life of the station.

There are other advantages, such as those arising from the close approach to ideal conditions resulting from the application of proper controls to a well-designed plant. Specifically, cooling water and crankcase oil temperatures are held more closely to optimum values in automatic operation. Controls can be selected to make the compressor unit follow load fluctuations closely and much more efficiently than usual with manual readjustment. This trend toward more automatic control is becoming a more general practice.

The principal disadvantages in operating automatic compressor stations are, first, the cost of equipping the stations with the necessary controls and limit switches and, second, the increased downtime occasioned by the fact that operating personnel are not continuously available to correct the condition causing the station to go down, immediately after that condition becomes evident.

The cost of controls and limit switches is nominal, in general, and a minor percentage of the total plant investment. The increased downtime is, of course, largely determined by the time lag between failure of the station and arrival of repair personnel. Downtime can be reduced substantially by carefully planned and scheduled maintenance procedure.

Our automatic compressor station at Cayuga, Texas, operated 97.3% of total elapsed time during the second year. The records show a minimum operating time for any one year of 95.5% and an average operating time during four years' operation of 96.3%. It seems reasonable to allow 0.5% downtime for maintenance of any internal combustion engine, so the maximum penalty paid for automatic operation in this instance is about 4% of total downtime.

Automatic compressor stations are here to stay. Reliability of the mechanical equipment and the control equipment required in such stations is excellent and improving from year to year. Costs of maintaining constant human attention at any station have increased very substantially during the past several years, and may or may not increase in the future. The present margin of savings in operating cost appears to justify the use of unattended stations in sizes up to at least 2000 HP., where infrequent shutdowns of the stations are not too undesirable.—"Automatic Compressor Stations" by T. S. Bacon, Lone Star Gas Co., Dallas.

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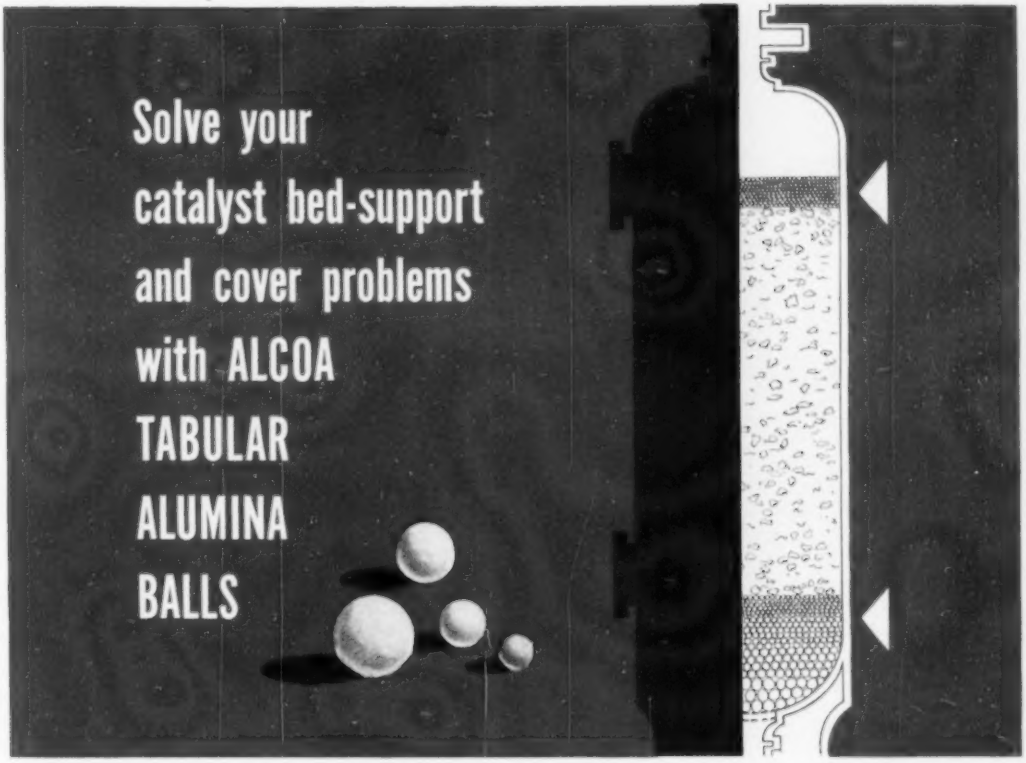

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REFINING TRENDS

Product Demand Improves in January Less Crude Run than in Early 1949

PRODUCT demand at refineries in January this year was at a higher rate than in the early weeks of 1949 and crude runs to stills were in lesser volume than in January, 1949. Stocks of distillate and residual fuels were drawn on substantially and residual fuel stocks for the refining areas east of the Rockies are at the lowest point since the middle of 1948.

Crude Runs to Stills—Runs of domestic crude in January were about 4.5% less than in January, 1949, but runs of imported crude were nearly 22% higher. Net result was a decrease of 143,000 b/d, or 2.6% from the volume of oil run last January. See Fig. 1. California cut its runs to stills back to 853,000 b/d, as compared with 930,000 in January, 1949. This district began to cut runs back in the latter months of 1949, after processing crude at the rate of 900,000 b/d through the early months of 1949.

The Bureau of Mines forecast crude runs in February of 5,430,000 b/d for the entire country, slightly under indicated runs during January.

Product Yields—Indicated yield of gasoline in January was 43%, about at the level of the past few months and compared with 41.1% in January, 1949. Kerosine yield of 7% in January, and distillate yield of 19.4% are higher than at the start of 1949. Indicated yield of residual fuel, 21.5%, is more than 2% under the first month of 1949.

Distillate Fuels—Indicated demand, including kerosine, in January was higher than in the same month of 1949. This reverses the trend throughout 1949 in which total demand was around 8% less than during the corresponding months of 1948. Indicated production of kerosine was around 12% higher in January, 1950, than the same period in 1949 and output of distillates about the same. For 11 months of 1949 refinery production of distillates was around 12% lower than in the same period in 1948.

A decline of over 15,000,000 bbls. in total distillate fuels stocks was indicated for January, of which around 13,000,000 bbls. is distillate and 2,500,000 bbls. kerosine. This reduction is not quite as large as that taking place in January, 1949, a total of around 17,000,000 bbls. of which 14,300,000 bbls. was in distillates.

Inland refineries reduced their stocks of distillate fuels by over 6,000,000 bbls. on January, their total standing at around 21,000,000 bbls. at the end of the month, as compared with total stocks of around 50,000,000 bbls. for East and Gulf Coast refineries at the end of January. In California distillate fuel stocks were reduced by around 2,000,000 bbls. during January.

Residual Fuels—Indicated refinery production was under that of January, 1949, by between 4 and 5%, it is indicated, while demand was slightly better. Production for 11 months of 1949 was 4.5% less than for 11 months in 1948, while demand for the same period was about 2% less.

Indicated stocks of this product at the end of January, 56 to 57,000,000 bbls. are at the lowest point for the country since the middle of 1948. California residual stocks have been cut by around 8,000,000 bbls. during the past two months. See Fig. 7.

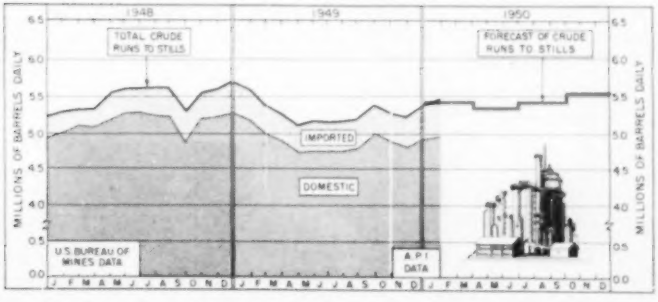
Motor Fuels—Indicated refinery output of gasoline in January, 2,624,000 b/d, was a little higher than in January, 1949, and was produced from less crude run to stills. Indicated gasoline yield from crude was 43%, as compared with 41% in the early part of 1949. Daily output was a little higher at East and Gulf Coast and at Inland refineries, but lower in California. For 11 months through November, 1949, total gasoline production was around 4.5% higher than the previous 11-month period.

Motor fuel demand in January continued at the rate of around 5-6% higher than the year before. This is about the rate of increase in demand prevailing through 1949.

Gasoline Stocks—Stocks (finished and unfinished) at the end of January were around 11,000,000 bbls. higher than at the end of December. Largest buildup in stocks during January was around 5,500,000 bbls. at Inland refineries; East and Gulf Coast refineries added between 3.5 and 4,000,000 bbls. and California refineries around 1,500,000 bbls.

As compared with the end of January, 1949, when total stocks were 116,621,000 bbls., the largest difference is in California, where stocks are 5,500,000 bbls. larger. East and Gulf Coast refineries stocks are 2,000,000 bbls. larger and at Inland refineries about at the same level.

Fig. 1—Runs to Stills—140,000 b/d Under Jan. 1949


1948
1949
1950
TOTAL CRUDE RUNS TO STILLS
FORECAST OF CRUDE RUNS TO STILLS
IMPORTED
DOMESTIC
U.S. BUREAU OF MINES DATA
API DATA
MILLIONS OF BARRELS DAILY
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D

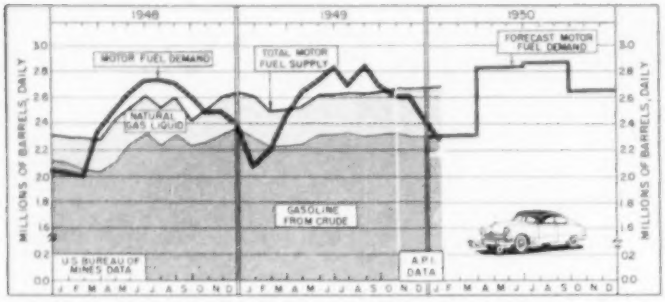
Crude Runs to Stills

	Daily Average (1000 bbls.) Domestic	Foreign	TOTAL
Jan. '50, API	4,995	585	5,430
Jan. '49, BM	5,229	415	5,644
Change	—234	+170	—143
% Change	4.5	22.7	2.6
	Total (1,000,000 bbls.) (Bureau of Mines data)		
11 Mo. '49	1,656.6	128.7	1,775.3
11 Mo. '48	1,742.1	111.2	1,853.6
Change	—185.5	+17.5	—78.3
% Change	6.0	24.8	4.2

Yields on Crude Runs to Stills

	Gasoline %	Kerosine %	Dist. Fuels %	Resid. Fuels %
Jan. '50, API	43.0	7.0	19.4	21.5
Dec. '49, API	43.6	6.3	19.1	21.4
Nov. '49, BM	43.5	5.7	18.6	21.9
Jan. '49, BM	41.1	6.0	18.7	23.7

Fig. 2—Gasoline—Demand Holding Up


1948
1949
1950
MOTOR FUEL DEMAND
TOTAL MOTOR FUEL SUPPLY
FORECAST MOTOR FUEL DEMAND
NATURAL GAS LIQUID
GASOLINE FROM CRUDE
U.S. BUREAU OF MINES DATA
API DATA
MILLIONS OF BARRELS, DAILY
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D

Natural Gas Liquids include natural gasoline blended at refineries, and used direct as motor fuel

Fig. 3—Gasoline Stocks—Increase Is Seasonal

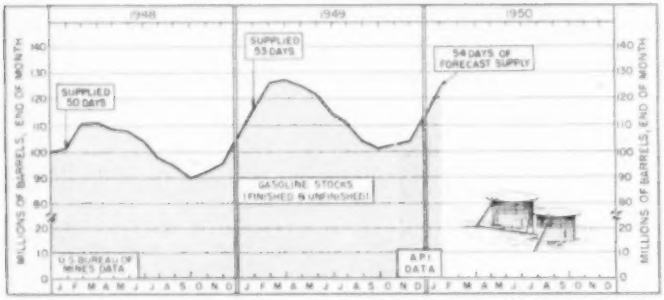

1948
1949
1950
SUPPLIED 50 DAYS
SUPPLIED 53 DAYS
54 DAYS OF FORECAST SUPPLY
GASOLINE STOCKS (FINISHED & UNFINISHED)
U.S. BUREAU OF MINES DATA
API DATA
MILLIONS OF BARRELS, END OF MONTH
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D

Fig. 4—Distillates—Demand Highest in Two Years

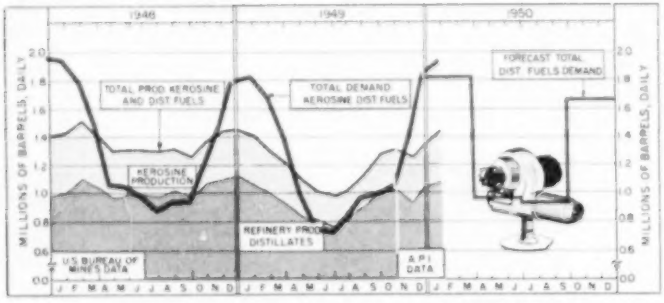
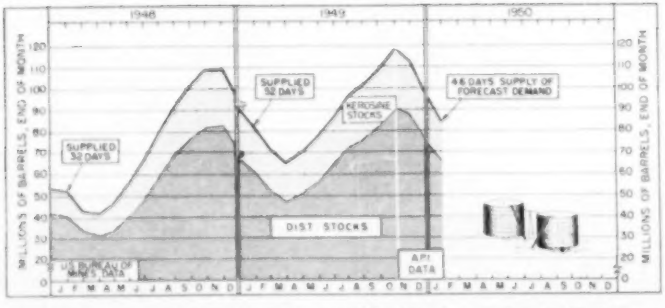

1948
1949
1950
TOTAL PROD KEROSINE AND DIST FUELS
TOTAL DEMAND KEROSINE DIST FUELS
FORECAST TOTAL DIST FUELS DEMAND
KEROSINE PRODUCTION
REFINERY PROD DISTILLATES
U.S. BUREAU OF MINES DATA
API DATA
MILLIONS OF BARRELS, DAILY
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D

Fig. 5—Distillate Stocks—Drop 15,000,000 Bbls.


1948
1949
1950
SUPPLIED 32 DAYS
SUPPLIED 32 DAYS
46 DAYS SUPPLY OF FORECAST DEMAND
KEROSINE STOCKS
DIST STOCKS
U.S. BUREAU OF MINES DATA
API DATA
MILLIONS OF BARRELS, END OF MONTH
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D

* Change in reporting in California eliminated 4,300,000 bbls. from distillate classification

Motor Fuel Supply

Daily Average (1000 bbls.)

	Gasoline from Crude	Natural Blended, Used Direct	TOTAL
Jan. '50, API	2,169	320	2,489
Jan. '49, BM	2,129	273	2,402
Change	+40	+47	+87
% Change	1.9	17.2	3.6

Total (1,000,000 bbls.) (Bureau of Mines data)

11 Mo. '49	779.3	99.0	878.3
11 Mo. '48	745.4	93.2	838.6
Change	+33.9	+5.8	+39.7
% Change	4.5	6.2	4.7

Motor Fuel Demand

Daily Average (1000 bbls.)

Jan. '50, API	2,304
Jan. '49, BM	2,168
Change	+136
% Change	6.3

Total (Bbls.) (Bureau of Mines data)

11 Mo. '49	875,022,000
11 Mo. '48	833,182,000
Change	+41,8
% Change	5.0

Gasoline Stocks

(Bbls., finished and unfinished)

Jan.* '50, API	126,276,000
Dec. '49, API	113,497,000
Nov. '49, BM	104,707,000
Jan. '49, BM	116,621,000

* As of Jan. 28th.

Distillates Production

Daily Average (1000 bbls.)

	Kerosine	Dist. Fuel	TOTAL
Jan. '50, API	383	1,062	1,445
Jan. '49, BM	340	1,063	1,403
Change	+43	—1	+42
% Change	12.9	0.1	3.0

Total (1,000,000 bbls.) (Bureau of Mines Data)

11 Mo. '49	91.3	307.5	398.8
11 Mo. '48	111.0	346.3	457.3
Change	—19.7	—38.8	—58.5
% Change	17.9	11.2	12.8

Distillates Demand

Daily Average (1000 bbls.)

	Kerosine	Dist. Fuel	TOTAL
Jan. '50, API	468	1,472	1,940
Jan. '49, BM	425	1,392	1,817
Change	+43	+80	+123
% Change	10.1	5.7	6.1

Total (1,000,000 bbls.) (Bureau of Mines Data)

11 Mo. '49	90.0	294.9	384.9
11 Mo. '48	103.0	319.3	422.3
Change	—13.0	—24.4	—37.4
% Change	12.6	7.6	8.8

Distillates Stocks

(1,000,000 bbls.)

	Kerosine	Dist. Fuel	TOTAL
Jan.* '50, API	18.4	66.3	84.7
Dec. '49, API	20.8	77.8	98.6
Nov. '49, BM	25.2	88.2	113.4
Jan. '49, BM	21.2	61.5	82.8

* Jan. 28th.

Fig. 6—Residuals—Refinery Output Is Low

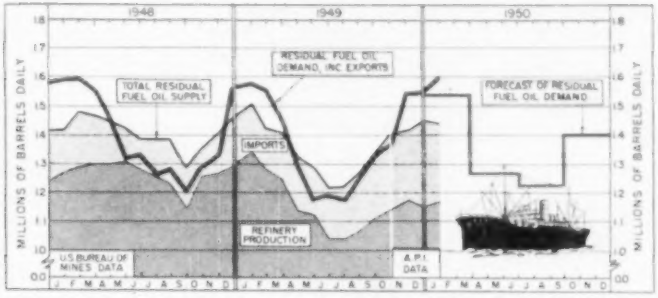
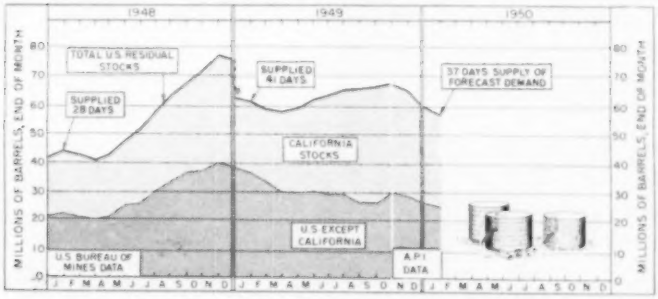

1948
1949
1950
MILLIONS OF BARRELS DAILY
TOTAL RESIDUAL FUEL OIL SUPPLY
RESIDUAL FUEL OIL DEMAND, INC EXPORTS
FORECAST OF RESIDUAL FUEL OIL DEMAND
IMPORTS
REFINERY PRODUCTION
U.S. BUREAU OF MINES DATA
API DATA
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D

Fig. 7—Residual Stocks—Sharp Cut in California


1948
1949
1950
MILLIONS OF BARRELS, END OF MONTH
TOTAL U.S. RESIDUAL STOCKS
SUPPLIED 41 DAYS
37 DAYS SUPPLY OF FORECAST DEMAND
SUPPLIED 28 DAYS
CALIFORNIA STOCKS
U.S. EXCEPT CALIFORNIA
U.S. BUREAU OF MINES DATA
API DATA
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D

† Change in reporting in California eliminated 13,000,000 bbls. from residual classification.

Residual Fuels Production

Daily Average (1000 bbls.)

	Refinery Production	Imports	TOTAL
Jan. '50, API	1,180	265	1,445
Jan. '49, BM	1,348	166	1,514
Change	—168	+99	—69
% Change	12.5	59.6	4.5

Total (1,000,000 bbls.) (Bureau of Mines Data)

11 Mo. '49	387.3	64.5	452.0
11 Mo. '48	423.8	47.8	471.7
Change	—36.5	+16.7	—21.7
% Change	8.9	34.9	4.5

Residual Fuels Demand

Daily Average (1000 bbls.)

Jan. '50, API	1,610
Jan. '49, BM	1,580
Change	+30
% Change	1.9

Total Demand (bbls.)

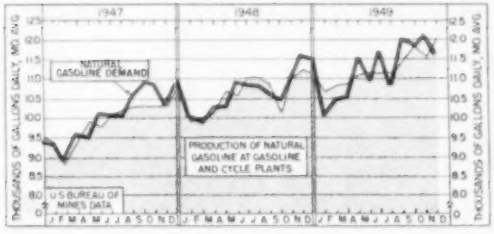
11 Mo. '49	455,377,000
11 Mo. '48	464,961,000
Change	9,584,000
% Change	2.1

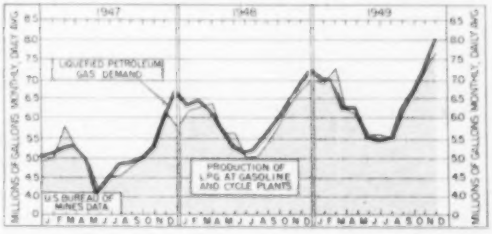
Residual Fuels Stocks (bbls.)

Jan.* '50, API	57,036,000
Dec. '49, API	61,615,000
Nov. '49, BM	65,112,000
Jan. '49, BM	82,568,000

* Jan. 28th.

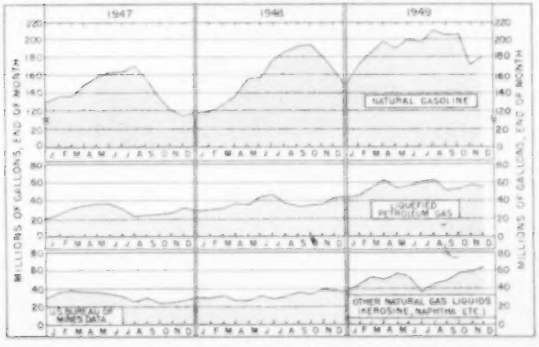
Fig. 8—Production and Demand of Natural Gas Liquids


1947
1948
1949
THOUSANDS OF GALLONS DAILY, MO. AVG.
NATURAL GASOLINE DEMAND
PRODUCTION OF NATURAL GASOLINE AT GASOLINE AND CYCLE PLANTS
U.S. BUREAU OF MINES DATA
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D


1947
1948
1949
MILLIONS OF GALLONS MONTHLY, DAILY AVG.
LIQUEFIED PETROLEUM GAS DEMAND
PRODUCTION OF LPG AT GASOLINE AND CYCLE PLANTS
U.S. BUREAU OF MINES DATA
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D

Scale on above chart should read "Millions of Gallons".

Fig. 9—Stocks of Natural Gas Liquids


1947
1948
1949
MILLIONS OF GALLONS, END OF MONTH
NATURAL GASOLINE
LIQUEFIED PETROLEUM GAS
OTHER NATURAL GAS LIQUIDS (KEROSINE, NAPHTHA, ETC.)
U.S. BUREAU OF MINES DATA
J F M A M J J A S O N D J F M A M J J A S O N D J F M A M J J A S O N D

Natural Gas Liquid Statistics

(Source: U. S. Bureau of Mines Report on Natural Gasoline and Cycle Plant Operations) †

	Production (1000 gal/day avg.) Natural Gasoline	LPG**	TOTAL	Demand* (1000 gal/day avg.) Natural Gasoline	LPG	TOTAL
Nov. '49	12,085	7,842	19,927	11,764	8,019	19,783
Nov. '48	11,322	6,720	18,042	11,733	6,820	18,553
Change	+763	+1,122	+1,885	+31	+1,199	+1,230
% Change	6.9	16.7	10.5	0.3	17.6	6.6
	Total Production (1000 gal)			Total Demand (1000 gal)		
11 Mo. '49	5,779,337	2,164,611	5,943,948	5,893,756	2,168,393	5,972,149
11 Mo. '48	5,541,805	1,963,510	5,545,315	5,585,717	1,985,536	5,569,453
Change	+197,532	+201,101	+398,633	+220,039	+182,857	+402,696
% Change	5.5	10.2	7.2	4.1	9.2	7.2

	Stocks, End of Month (1000 gal) By Type of Product: Natural Gasoline	LPG	Other Products†	By Location: Refineries	Gasoline Plant	TOTAL
Nov. '49	180,927	55,546	63,458	86,352	213,579	299,931
Oct. '49	175,481	57,351	59,948	87,664	202,918	290,582
Nov. '48	156,580	40,813	38,617	66,946	178,164	246,010

* Demand is made up from outside receipts and stock changes as well as current production.

** Does not include LPG produced at refineries, which in Nov. '49 totaled 76,776,000 gal.

† Includes kerosine, naphtha, specialty products and others.

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PERCO DIVISION • CHEMICAL PRODUCTS DEPARTMENT
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*A SERVICE MARK

[*To obtain more data on advertised products see page* 192]

Book Reviews

British Petroleum Institute Issues 10th Edition of Tests

Standard Methods for Testing Petroleum and Its Products, 10th Edition, 1949; 5½ x 8½ in., Lvi + 660 pages, paper binding, 31s 6d. The Institute of Petroleum, 26, Portland Place, London W.1, England.

The newest edition of the British Institute of Petroleum's *Standard Methods* presents three new methods of test, not covered in the previous (1948) edition. They are: 1) an engine method of testing heavy-duty lubricants in relation to ring-sticking, wear, and deposit accumulation, 2) a method for Research octane number of motor fuels, and 3) a method of assessing the corrosive tendencies of cutting oils in contact with cast iron. In addition, 18 standard methods and two specifications have been revised and brought up to date.

It is now 25 years since the Institute, then the Institution of Petroleum Technologists, published its first edition of this volume. At that time it was a small volume of 102 pages, describing some 40 methods of test. The present edition contains 116 methods in some 660 pages.

Publish New Second Edition Of Scientific Signs, Symbols

Scientific and Technical Abbreviations, Signs and Symbols, 2nd Ed., by O. T. Zimmerman and Irvin Lavine; 5½ x 8¼ in., xiv + 541 pages, indexed, illustrated, stiff cloth binding, $8.00. Industrial Research Service, Dover, N. H.

This new second edition of *Scientific and Technical Abbreviations, Signs, and Symbols*, appearing only a year after the first edition, has been issued to bring up to date the information in this field developed by the American Standards Assoc. in new standards for physics, electrical quantities, and the like, as well as important revisions in a number of earlier American Standards.

Among signs, symbols, etc. covered in the present volume are those in the general fields of mathematics and statistics, chemistry and chemical engineering, physics, thermodynamics, mechanics and hydraulics, materials of construction and shop terms, electricity and electronics, aeronautics, meteorology, commerce, and proof reading.

Dr. Zimmerman is professor of chemical engineering, University of New Hampshire, and Dr. Lavine is formerly professor and head of dept. of chemical engineering, University of North Dakota.

Harvard Study Covers Avgas And Plane Engine Research

Development of Aircraft Engines, by Robert Schlaifer, and *Development of Aviation Fuels*, by S. D. Heron; one volume, 6 x 8½ in., 754 pages, stiff cloth binding, indexed, $5.75. (1950) Harvard Business School, Division of Research, Soldiers Field, Boston 63, Mass.

Development of Aircraft Engines and *Development of Aviation Fuels* constitute two research studies sponsored by the Harvard Business School, and focused primarily on the question: "How can government and industry work together to keep our technical research and development up to, or ahead of, that in other countries?"

The studies trace the developments in both fields since the First World War and include recommendations for the future based upon experiences of government and industry working together and separately. Mr. Schlaifer notes the speedy development of superior engines by companies working without close government supervision. Mr. Heron's section of the book emphasizes the objective of quantity production of high quality fuels at a reasonable cost.

Professor Schlaifer, whose earlier experience combined that of a physicist with that of a historian, is assistant professor of business administration at the Harvard Business School. Mr. Heron, for 36 years in fuel and engine development for both government and industry in England and the United States, is a consulting engineer in Detroit.

Petroleum Progress to 1946 Surveyed in British Volume

Reviews of Petroleum Technology, Vol. 8, 1946, edited by Sell, Garner, and Evans; 6 x 9 in., viii + 445 pp., indexed, stiff cloth binding, 27s. 6d. (1949). The Institute of Petroleum, Manson House, 26, Portland Place, London, W.1.

Literature surveys of the class represented by *Reviews of Petroleum Technology* always are invaluable additions to the petroleum engineer's library. Unfortunately in most cases they are a trifle out-dated because of the relative slowness of book compilation and publishing. This new British volume is no exception, but understandably so, considering the conditions existing in England today, in the book as in many other industries.

It does cover, however, an important gap which had been created because of the recent conflict: it covers the year 1946 and is the first annual publication since the war. The editor explains in the preface that it is hoped future editions will appear closer to the year to which they refer. Several important subjects again are included which had been omitted in the previous volume (1941-1945). These are gasoline and light distillates, furnace fuel oils, and lubricants and lubrication. The section on lubes comprises 73 pages and over 1100 literature references. There are over 3000 references in the entire book.

The bulk of this work is of interest to the processing man, some 400 pages being devoted to refining processes and products, testing and analysis, petroleum hydrocarbon chemistry and physics, and synthetic fuels.

Leading British technologists have contributed the data and reviews contained in the 27 major chapters. George Sell is the editor, assisted by F. H. Garner and E. B. Evans as honorary editors. The book should be ordered direct from the Institute of Petroleum, London.

German Acetylene Chemistry And CO Synthesis Surveyed

Acetylene and Carbon Monoxide Chemistry, by Copenhaver and Bigelow; 6 x 9 in., xvi + 337 pages, stiff cloth binding, indexed, illustrated, $10.00. (1949). Reinhold Publishing Corp., 330 West 42nd St., New York 18, N. Y.

Although a number of individual reports by American and British investigation teams who went into Germany following the recent war have been published covering some aspects in this general field, *Acetylene and Carbon Monoxide Chemistry* brings together in one volume and in considerable detail all major chemical processes based on acetylene, with particular reference to the newer developments in Germany, in this country, and elsewhere. Available information up to 1949 has been included.

The book traces the development of the chemistry of acetylene under pressure; the application of this technique to the four fields of vinylation, ethinylation, polymerization, and carboxylation; the hazards involved; and the procedures and equipment needed to insure safety. The newer phases of carbon monoxide chemistry are covered as well as many new processes for making synthetic oils and lubricants, natural and synthetic fuel gases, synthetic rubbers, organic chemicals, resins, and the like.

Unfortunately, as the authors point out in their foreword, the preparation of the material from literally tons of documents, notes, etc., was beset with many difficulties. Dr. Walter Reppe, Germany's leading scientist in the field of acetylene chemistry, was also a Nazi; and to all intents and purposes, still is a Nazi. Consequently, his assistance was at best of poor quality. As a result, sections of

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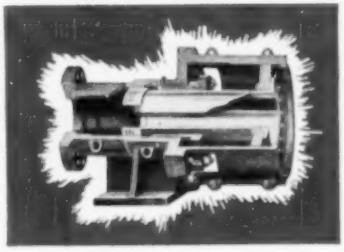

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Book Reviews

the information are admittedly sketchy.

However, actual operating conditions and yields for many processes are presented in this book for the first time, and the authors have carefully evaluated the merits of many of these new syntheses.

John W. Copenhaver was engaged in exploratory research in acetylene chemistry in the Central Research Laboratory, General Aniline and Film Corp., from 1943 to 1949. He is presently associated with the Petroleum and Chemical Research Laboratory, M. W. Kellogg Co. Maurice H. Bigelow is Technical Director, Plaskon Division, Libbey-Owens-Ford Glass Co. Both men were instrumental in uncovering, assembling, and rewriting the estimated 28 tons of documents from the widely scattered files of Dr. Reppe in Germany. Lt. Col. Bigelow was the executive officer of the Chemical Corps in the European Theatre.

Other New Books

Industrial Chemistry, 5th Ed., by E. R. Riegel; 6 x 9 in., xiii + 1015 pp., stiff cloth binding, indexed, illustrated, $7.00. A revision of this widely used college text, the last previous edition of which was in 1942. Reinhold Publishing Corp., 330 West 42nd St., New York 18, N. Y.

Colorimetric Methods of Analysis. Including Some Turbidimetric and Nephelometric Methods, 3rd Ed., Vol. II, Inorganic, by Snell and Snell; 6 x 9 in., x + 950 pp., stiff cloth binding, indexed, illustrated, $12.00. D. Van Nostrand Co., Inc., 250 Fourth Ave., New York City.

Bottom-Up Management, People Working Together, by William B. Given, Jr., President, American Brake Shoe Co.; 5¼ x 8 in., ix + 171 pp., stiff cloth binding, $2.50. Harper & Bros., 49 East 33rd St., New York 16, N. Y.

Dynamic Equipment Policy, by George Terbrogh, A Machinery & Allied Products Institute study; 6 x 9 in., xxiii + 290 pp., indexed, $3.75. McGraw-Hill Book Co., 330 West 42nd St., New York 18, N. Y.

Association Publications

Metal Cleaning Bibliographical Abstracts, Special Technical Publication No. 90, American Society for Testing Materials, prepared by Jay C. Harris; 6 x 9 in., 72 pages, heavy paper binding, $2.75. Order from the ASTM, 1916 Race St., Philadelphia 3, Penna.

Manual on Disposal of Refinery Wastes, Sect. I, Waste Water Con-

Book Reviews

taining Oil, 4th Ed.; 8½ x 11 in., 84 pp., paper binding, $2.00. Order direct from the publisher: attn. J. A. McNally, American Petroleum Institute, 50 West 50th St., New York 20, N. Y.

Standards of Tubular Exchanger Manufacturers Association, 2nd Ed., 8½ x 11 in., 94 pp., illustrated, indexed; paper cover, $3.00; fabrikoid cover, $4.00. Order direct from Geo. P. Byrnes, Jr., Sec'y-Treas., Tubular Exchanger Manufacturers Association, 53 Park Place, New York 7, N. Y. Distribution not restricted to TEMA members.

MEETINGS
. . . for the Oil Man

FEBRUARY

12-16, American Institute of Mining & Metallurgical Engineers, Annual Meeting, Pennsylvania Hotel, New York.

20-24, American Society for Testing Materials, Committee D-2 on Petroleum and Petroleum Products, Spring Meeting, The Shoreham, Washington, D. C.

24, Western Petroleum Refiners Assn., Regional Technical Meeting, Washington-Youree Hotel, Shreveport.

26-Mar. 1, American Institute of Chemical Engineers, Regional Meeting, Rice Hotel, Houston.

27-Mar. 3, American Society for Testing Materials, Committee Week and Spring Meeting, Hotel William Penn, Pittsburgh.

MARCH

26-30, American Chemical Society, 117th National Meeting (divided), Houston.

27-29, Western Petroleum Refiners Assn., 38th Annual Meeting, Plaza Hotel, San Antonio.

28-31, Greater New York Safety Council, 20th Annual Safety Convention and Exposition, Hotel Statler and Hotel Governor Clinton, New York.

APRIL

4-7, National Assn. of Corrosion Engineers, Jefferson Hotel, St. Louis, Mo.

5-7, Illinois Institute of Technology, Midwest Power Conference, Sherman Hotel, Chicago.

9-13, American Chemical Society, 117th National Meeting (divided), Philadelphia.

10-12, American Society of Lubrication Engineers, Hotel Statler, Detroit.

10-14, American Society of Mechanical Engineers, Hotel Statler, Washington.

12-14, National Petroleum Assn., Semi-Annual Meeting, Hotel Cleveland, Cleveland.

16-20, American Chemical Society, 117th National Meeting (divided), Detroit.

17-19, Society of Automotive Engineers, Aeronautic and Aircraft Engineering Display, Statler Hotel, New York.

24-25, Industrial Accident Prevention Assn., Royal York Hotel, Toronto, Canada.

24-26, Natural Gasoline Assn. of America, 29th Annual Convention, Texas Hotel, Fort Worth.

24-26, American Society of Mechanical Engineers, Process Industries, William Penn Hotel, Pittsburgh.

24-27, American Management Assn., 19th National Packaging Exposition, Navy Pier, Chicago.

MAY

1-4, American Petroleum Institute, Refining Division, Annual Spring Meeting, Hotel Cleveland, Cleveland.

8-11, Liquefied Petroleum Gas Assn., Annual Convention and Trade Show, Palmer House, Chicago.

15-18, National Fire Protection Assn., American Gas Assn., Exhibit, Haddon Hall, Atlantic City.

22-24, American Gas Assn., Production and Chemical Conference, Hotel New Yorker, New York.

28-31, American Institute of Chemical Engineers, Regional Meeting, New Ocean House, Swampscott, Mass.

JUNE

4-9, Society of Automotive Engineers, Summer Meeting, French Lick Springs Hotel, French Lick, Ind.

ACCURATE PIPE CUTS
Quick and Easy

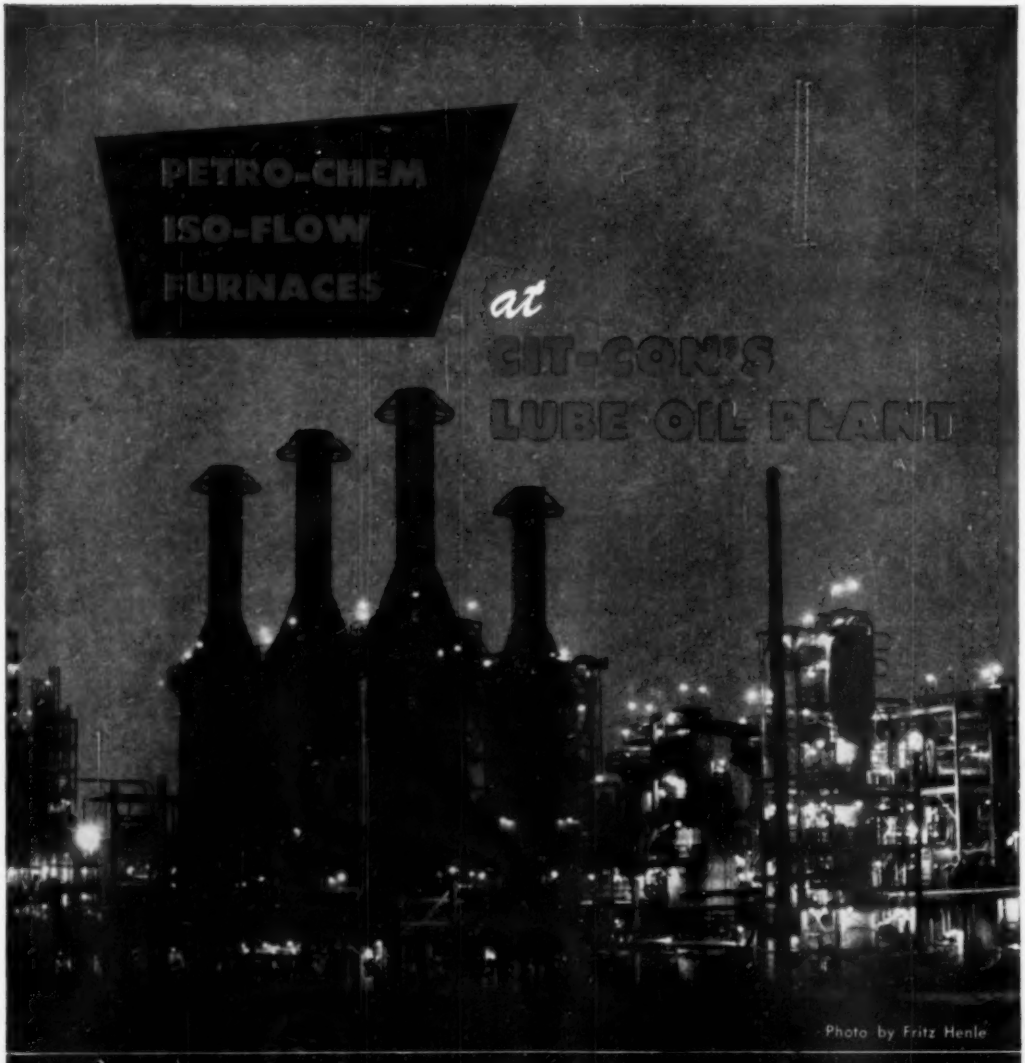
"Anybody does better work with better tools—If they come any better than RIDGID I've never seen 'em."
RIDGID
No. 2 HEAVY DUTY
1/8 TO 2

RIDGID Cutters roll right through all kinds of pipe and conduit

● It's really a cinch to cut pipe extra fast with the popular efficiency-balanced RIDGID cutter. Thin heat-treated tool-steel blade leaves practically no burr. Every cutter factory-tested to make sure it tracks perfectly. Your choice of five sizes to 6" pipe; four-wheel cutters to 4." Choose the favorite of men who know fine tools—buy RIDGID cutters at your Supply House.

RIDGID
WORK-SAVER PIPE TOOLS
THE RIDGE TOOL CO. • ELYRIA, OHIO

[*To obtain more data on advertised products see page* 192]



PETR CHEM

ISO-FLOW FURNACES

UNLIMITED IN SIZE ... CAPACITY ... DUTY

PETRO-CHEM DEVELOPMENT CO., INCORPORATED

120 EAST 41ST STREET, NEW YORK 17, N. Y.

Representatives:

Bethlehem Supply, Tulsa and Houston · Flagg, Brackett & Durgin, Boston · D. D. Foster, Pittsburgh · Faville-Levally, Chicago · Lester Oberholz, Calif.

NEWS OF

Manufacturers—Suppliers—Engineering Firms

Serving the Petroleum Processing Industry

Welding Mask Permits Fast Repairs On Tanks Containing Toxic Vapors

New welding facepiece provides complete eye, face, and respiratory protection during repairs on tanks used for leaded gasoline. Model shown is a combination fresh air hose mask

A new device which enables a welder to work safely in atmospheres containing toxic vapors, dusts, and fumes has been developed successfully as an answer to the problems encountered by the petroleum industry in the storage and handling of leaded gasolines.

William A. Newman of the safety department of Ethyl Corp., in collaboration with representatives of several oil companies and Mine Safety Appliances Co., developed the equipment. Ethyl was interested in providing means to repair gasoline tanks safely without costly tank cleaning and preparing operations.

The device is said to combine in one unit protection against ultraviolet and infra-red radiation, impact and pitting, and inhalation of toxic fumes. The facepiece assembly consists of an air-tight rubber mask and a chrome leather hood with flexible breathing tube connections.

Three lenses are used. One is a permanent safety lens sealed into the assembly; the other two are removable welding and pitting lenses inserted in the flip front. The new facepiece provides 81° lateral angle vision in contrast with 60½° with the standard welding shield. The vertical angle is 37° as against 30° in the standard design.

When the mask is connected with an approved air line, the incoming air stream enters at chin level and flows over the lens window to prevent fogging. Two spent air outlets at jaw level direct the air stream around the interior of the hood. The facepiece is adaptable to three types of masks: combination fresh air hose, air line respirator, and all-service canister. The latter two are for use only outside tanks.

Before development of this mask, it was necessary for a cleaning crew to spend several days preparing a tank which had contained leaded gasoline for welding—not only to free it of explosive vapors but also to remove sludge, rust, scale, and dust. It also was considered good practice to operate a mechanical ventilator on top of the tank to exhaust fumes during welding.

With the new mask, all that is needed prior to welding is to eliminate the explosion hazard in the tank and the underlying soil. Welding operations then can be performed in a fraction of the time previously required as long as the new mask is used with an approved fresh air supply line.

Waterous Pumps in Record Unloading

A new record for pumping out crude oil barges on the Mississippi River was set recently at Northwestern Refining Co.'s docks at St. Paul Park, Minn., it is reported. Using four rotary cargo pumps built by Waterous Co., a tow of 48,000 bbls. was emptied in less than nine hours.

J. M. Vyn, Northwestern's refinery superintendent, reports that the pumps used in this operation have been in service for the past four seasons with absolutely no maintenance and have consistently pumped in excess of their rated capacity.

Tube-Turns Sets Up Plant in Ontario

Tube Turns of Canada, Ltd., which was granted its Dominion charter in December, is establishing a plant in Chatham, Ont., for the manufacture of Tube-Turn welding fittings. The two-story brick building is located on the north side of Colborne St., between Adelaide and William. Preparations are now under way for the installation of machinery and facilities. Operations are expected to start about April 1, 1950.

Cooper Alloy Fills Executive Post

The appointment of Herbert J. Cooper as assistant to the general manager, Cooper Alloy Foundry Co., has been announced by Dan Talbott, vice president and general manager.

Prior to joining Cooper, Mr. Cooper was with Bethlehem Steel Corp. engaged in practical research in the development of centrifugal casting and oxygen injection techniques. He is a member of the American Foundrymen's Society, the American Society of Mechanical Engineers, American Society of Metals, and the Shop Practice Committee of the Alloy Casting Institute.

Millett and Dennis Up at Graver Tank

Robert F. Millett, formerly in charge of midwestern advertising for Cities Service Oil Co. (Del.), has been appointed advertising manager for Graver Tank & Mfg. Co., Inc., East Chicago, Ind.

Graver also named Harry A. Dennis as sales manager recently for the company's Stainless and Alloy Steels Division. He will continue his present assignment as manager of weldment sales. Prior to his association with Graver, Mr. Dennis was assistant district manager of sales for Lukens Steel Co.

Arco Names Sales Director

Mr. Edlund

Harold A. Edlund has been appointed director of sales of the Arco Co., manufacturers of paints and related industrial maintenance products. He will make his headquarters in the company's executive offices in Cleveland. Mr. Edlund, previously associated with General Aniline and Film Corp., had been western sales manager of its Ansco Division since 1946. Located in Chicago, he was in charge of sales, warehouse and branch office operations for the area including Chicago, Dallas, Los Angeles, and San Francisco territories.

Diamond Expands in Sodium Silicate

A constantly growing demand in the oil industry for silica gel catalyst has been cited as the primary reason for a 50% expansion in facilities for the production of sodium silicate and related products at Diamond Alkali Co.'s Cincinnati plant.

The company in late January put

How *Precision Streamliner Laboratory Water Stills

GIVE PURER DISTILLATE

Make Your Work Easier... Cut Costs

- Pre-heated constant-level raw water saves heat and watching
- Vapor Seal eliminates troublesome gaskets, speeds cleaning
- Oversize vapor-flue avoids foaming, carry-over of solids, hard water-problem
- Vapor spreader and maze slows flow, "scrubs out" *all* impurities
- Vast, open condenser gives maximum surface, minimum cleaning
- Heavy block tin prevents metallic contamination, wears longer
- Special vent carries off volatiles at top of vapor-rise
- Insulated evaporator speeds output, cuts heat cost
- Skilfully simple design permits 10-second take-down, easiest cleaning
- "Crafted" construction gives far longer worry-free service, neatness
- Wide selection—steam, gas, electric; 1 to 4 gallons per hour—suits any need

*Many of these features are *Precision exclusives—yet you pay no more for this certain satisfaction. Order from your supplier now . . . or write us for Bulletin 7-910.*

NOW! Exteriors All Stainless Steel.

Precision Scientific Company

* *The FINEST Research & Production Control Apparatus*
3737 W. Cortland Street, Chicago 47
OFFICES IN NEW YORK • PHILADELPHIA • SAN FRANCISCO

[*To obtain more data on advertised products see page* 192]

into operation a new 50,000-ton furnace, raising facilities at Cincinnati to three such furnaces. Total cost of the expansion project, which included enlarging and remodeling the furnace building, was $300,000.

The name of the Emeryville Chemical Co., operating a sodium silicate plant at Emeryville, Calif., has been changed to Diamond Alkali Co. of California. The firm will continue as a wholly-owned subsidiary of Diamond, who purchased it in 1944.

Business Briefs

Lukens Steel Co. and its divisions will be represented by **David W. Jones, Jr.**, Denver, Colo., in the sale of steel plate in the Rocky Mountain area, including Colorado, Idaho, Montana, Utah, and Wyoming. The region will remain under the jurisdiction of Lukens' Chicago district sales office.

Graver Water Conditioning Co. announces the appointment of **Brookman-Kron Associates** as its sales engineering representative in the Buffalo, N. Y., territory, with headquarters at 259 Delaware Ave., Buffalo 2.

Weston Electrical Instrument Corp.—Anthony H. Lamb has been appointed vice president, and will assume responsibility for the operation of the recently acquired Tagliabue Division. Mr. Lamb is credited with many patents and has been responsible for the pioneering activity in the field of photoelectricity.

A. O. Smith Corp.—A. L. Sobey has been named chicago area sales representative for SMITHway Computing Pumps. Operating as A. L. Sobey Equipment Co., he is establishing offices at 624 So. Michigan Ave., Chicago 5.

Cooper Alloy Foundry Co.—Wayne Karber has been made sales engineer in charge of cast stainless steels for **Wm. G. Boales & Associates,** Detroit manufacturer's representatives for Cooper.

Hammond Iron Works announce the appointment of Thomas F. Fitzgerald, 75 Federal St., Boston, Mass., as engineering sales representative in that area. He will be concerned with the requirements of the petrochemical industry.

Houdry Process Corp. has moved its principal offices to 1528 Walnut St., Philadelphia 2, Penna. Telephone is PEnnypacker 5-9490.

Jerguson Gage & Valve Co.—James A. Ford, who came to the company in 1945 as sales manager, has been elected vice president and director.

You get a great deal

When You Buy Wolverine Condenser Tubes

Quality Controlled
FROM ORE TO FINISHED PRODUCT.

WOLVERINE TUBE DIVISION
Calumet & Hecla Consolidated Copper Co.
1425 CENTRAL AVE. · DETROIT 9, MICHIGAN
MANUFACTURERS OF SEAMLESS, NON-FERROUS TUBING

PLANTS IN DETROIT AND DECATUR, ALA.
Sales Offices in Principal Cities

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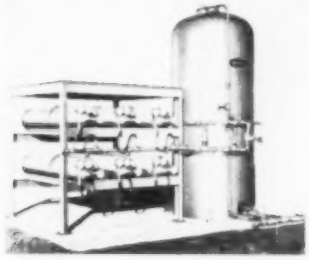
What's New!

EQUIPMENT . . . MATERIALS . . . PROCESSES . . . LITERATURE

Reviewed by WILLIAM C. UHL, Equipment Editor

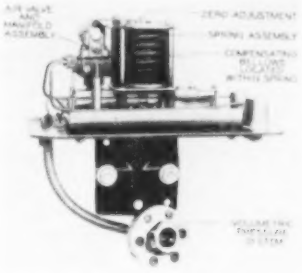
Stationary Fire Fighting Unit Designed For Gasoline Plants and Refineries



Large stationary fire fighting units, using dry chemical and inert gas, are now being made available in 500, 1000, and 2000 lb. capacities—measured in terms of dry powder. They have been designed to protect wide areas where a minimum of manpower is available such as refineries, natural gasoline plants, gasoline storage areas and bulk plants, LPG tank farms, or any chemical plants involving flammable gases and liquids. They are expected to be particularly adapted to use where only one employe, such as a night watchman, is available for emergency fire duty. One person can operate one of these stationary units and fight a fire in any portion of an area several acres in size, it is stated. The unit comprises a centrally located steel tank containing dry chemical, and the required number of nitrogen cylinders (for pressurizing the tank). Piping runs underground to one or more hose houses where one-inch chemical engine hose is coiled. Hose may be obtained in 50, 100, and 150-ft. lengths. Flow rate of the chemical is 450 lbs./min. Recoil, a problem with this high rate of discharge, has been minimized by a special nozzle. Ansul Chemical Co.

Check No. 1 on Reply Card

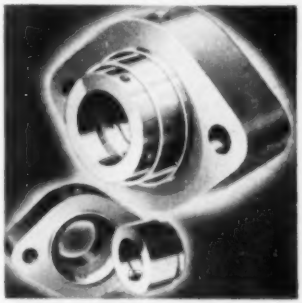
Force-balance Pressure Transmitter Has 0.5% Accuracy up to 1000 ft.



A force-balance type of pressure transmitter, the "Transaire" design, has been developed as a companion instrument to the Transaire Temperature Transmitter, which was announced last year. The new pressure transmitter makes it possible to measure and transmit up to 1000 ft. the smallest of pressure changes with an accuracy of 0.5% of the range span. Narrow range spans of 20 to 40 psi. are available in the instrument over limits of 35 to 415 psi. with sensitivity of 0.1% or 0.02 or 0.04 psi. depending on the span used. Regardless of the span, the transmitter output is always linear from 3 to 15 psig., eleminating the need for individual calibration of matching receivers or receiver-controllers. Operating ranges can be varied by a simple screw driver adjustment. Taylor Instrument Cos.

Check No. 2 on Reply Card

Shaft Seal Effective for Hydrocarbons At Conditions to 600 psi. and 250° F.



Three major improvements in design are cited for the "Fel-Pro" Type H-P Seal for equipment handling hydrocarbons under high pressures and temperatures. First, control and balance of hydraulic pressures eliminate the problem of excessive sealing face wear; second, a reduction in the number of parts susceptible to wear and deterioration minimizes operation and maintenance; third, a simplified cooling method eliminates the need for auxiliary cooling systems. The seals are designed for pressures up to 600 psi. and temperatures up to 250° F. in centrifugal pumps and other equipment handling gasoline, crude oils, propanes. Felt Products Mfg. Co.

Check No. 3 on Reply Card

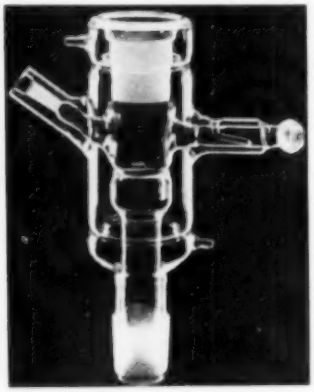
Thermometer Wells Made Standard In Glenlab's Column Feed Sections

Additional temperature-measuring facilities have been provided in the new redesigned "Glenlab" feed sections for laboratory fractionating columns. These devices are used to permit the insertion of a continuous feed at an intermediate point in columns of various types. A well has been included to accommodate a 3-in. immersion thermometer or a thermocouple directly in the rising vapor stream, and a second thermo-

For More Information

Use one of the attached reply cards to request additional information or literature on any items reviewed in "What's New!" Just check the numbers corresponding to the numbers on the items you're interested in, fill in the rest of the card, and drop it in the mail. No postage required.

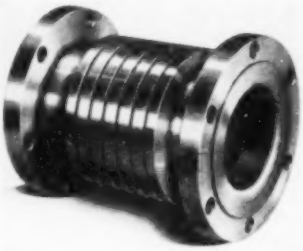
couple well is located in the input-connector projection and positioned for intimate contact with the fluid, even at minimum flow rates. The 1 and 2-in. feed sections include thermal-insulating jackets (as illustrated) with high vacuum pumped at high temperatures; an observation window in the jacket silvering for watching liquid return; temperature-compensating bellows to permit operation up to 500° F. and of internal-convolution design to minimize possible mechanical damage. Either spherical or standard taper glass joints can be supplied on the top and bottom connections, to match corresponding column sections. Two larger size feed sections—3 and 4-in.—are supplied with vacuum jackets. Glass Engrg. Laboratories.



Check No. 4 on Reply Card

Expansion Joints Using Stainless Steel Or Other Alloys Withstand 1000 psi.

The "Flexoniflex" line of expansion joints, designed for the 1000 psi. working pressure range and used for several years in critical confidential projects, now are available for use wherever gases or fluids must be conveyed under high pressures and between relatively movable parts. The joints consist of corrugated, bellows-type, sections of stainless steel or other alloys formed within integral control rings and end sections. Unlike control rings normally used on controlled-flexing expansion joints, the rings on these units are not bolted in place but have intimate relationship with the pressure carrier. Standard models are made with single or multiple plies and may be lined or unlined depending on application. Sizes begin at $\frac{3}{8}$-in. I. D. and continue through the range of extra high pressure pipe sizes. Tem-



perature range is from sub-zero to 1400° F. for stainless steel. The upper limit can be exceeded with special alloys. Chicago Metal Hose Corp.

Check No. 5 on Reply Card

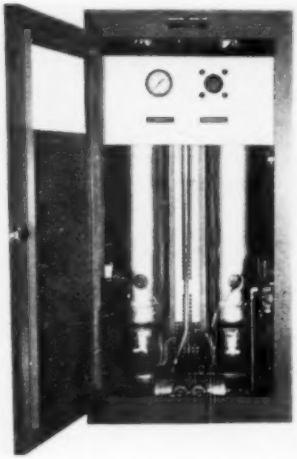
Rapid Load Changes Have No Effects On Operation of Two-stage Deaerator

Rapid load variations or unusual operating conditions are said to have no effect on the ability of the new, two-stage, Graver Deaerating Heater to reduce the oxygen content of boiler feedwater to less than 0.005 ml/liter, measured by the ASTM Referee Method or the modified Winkler Test. Carbon dioxide is also completely removed, assuring protection of boilers and accessories from corrosion and pitting. Spring-loaded, self-adjusting, spray valves in the first stage cause heating of the incoming water to within 2-4° F. of the steam so as to remove virtually all the oxygen and free CO_2. In the second stage, the preheated water is intimately mixed with a large excess of incoming steam by special scrubbing baffles, so that a major portion of the steam which remains as vapor carries with it the small traces of undissolved gases on its way to the first stage where it heats the incoming water. Heaters are available in sizes up to 2 million lbs./hr., with the second stage tailor-made for individual plant conditions and the desired storage capacity. Graver Water Conditioning Co.

Check No. 6 on Reply Card

Instrument Air Drying Units Available At Moderate Cost in Two Capacities

The new Model 50 and Model 25 EIAC Dynamic Dehumidifiers are said to be the first moderately priced units to be placed on the market. They are designed primarily for industrial instrument air supply for reducing maintenance by eliminating the formation of condensate in air lines and the possibility of freezing up in out-of-doors locations. Completely automatic operation from 110 volt, 60 cycle current is provided. Designed capacity of the Model 50 is continuous drying of 50 SCFM of air at 100 psig. and 70° F. to maximum dewpoint of −40° F.; the Model 25 is for 25 SCFM. Cabinet dimensions are 22 in. wide, 18 in. deep, and 43 in. high, for floor or table mounting, with all piping and electrical connections terminating at the bottom back of the cabinet. The unit can be mounted within six in. of a wall. Industrol Corp.



Check No. 7 on Reply Card

Stainless Steel Sampling Units Made For 400 and 1800 psi. Pressures

Now being offered as an aid for either production run or laboratory sampling is the Hoke Stainless Steel Pressure Sample Container. It is available in two standard service pressure ranges of 400 and 1800 psi. Manufacturer states the units are ICC approved. They may be obtained for either single or double valving. 18-8 stainless steel is used, but other metals, ferrous or non-ferrous can be supplied on special order. Hoke, Inc.

Check No. 8 on Reply Card

For highest uniformity of catalyst characteristics--

DAVISON FLUID SYNTHETIC CRACKING CATALYST....

...In addition Davison offers you

FACILITIES—Plants located in Baltimore and Cincinnati assure you of fast service from established sources.

EXPERIENCE—You receive the benefits of our experience as the oldest producer of fluid synthetic cracking catalysts.

SERVICE—Davison service includes new and expanded facilities for catalyst evaluation and trouble-shooting.

More and more leading refineries are standardizing on Davison DA-1 as the synthetic cracking catalyst known to them to give the maximum efficiency and economy in operation. DA-1 is available as . . . F-1, FINE GRIND; C-1, INTERMEDIATE GRIND; C-2, COARSE GRIND . . . all produced under close laboratory control to maintain the high standard of uniformity in physical, chemical and catalytic characteristics . . . your assurance of maximum catalyst utilization.

For special processes, Davison can place at your service an experienced staff and a modern, new plant devoted exclusively to the development and production of custom catalysts in granulated, powdered or pelleted form.

WRITE FOR INFORMATION AND SPECIFICATIONS

THE DAVISON CHEMICAL CORPORATION

Progress Through Chemistry

BALTIMORE-3, MD.

PANELGRAPH

the *direct* approach to
ON STREAM operation

visualize your entire plant at a glance

SPECIFY

PANELLIT

for the PREFABRICATED
PANEL TO FIT YOUR PROCESS

The Panelgraph in This Unusual Control Room of Cosden Petroleum Corporation at Big Spring Texas Controls Operation of the Fluid Catalytic Cracker (As Described in the January Issue of Petroleum Processing).

• • • •

The above panel completely prefabricated by **PANELLIT.**
Send for Brochure describing similar installations.
Catalogues also available for Conventional Prefabricated Panels, Consoles, Cubicles, Panalarm Signals.

PROCESS INDUSTRIES
POWER PLANTS
REFINERIES

PANELLIT, INC.
7212 N. Clark Street • Chicago 26, Illinois

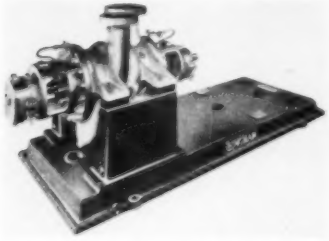
What's New!

Tank Lining Resists Sour Crudes, Most Oils and Petroleum Solvents

A new plastic coating for petroleum and chemical tanks, called "Vinyl-Cote," is said to provide an impervious lining which does not blister, eliminating the peeling commonly encountered in plastic coatings. Field tests have shown it withstands sour crude, salt water, alkalies, and acids. Derived from vinyl copolymer resins, the material is almost totally unaffected by oils, greases, and petroleum solvents, manufacturer states. However, it is readily soluble in the ketone and ester group of solvents and its resin films will not hold up under operating temperatures above 180° F. It is applied in five coats, with each coat a different color, applied to a specified exact thickness. The first test applications, nearly three years ago in actual tanks in the Gulf Coast and midwestern oil fields, are said to be still in excellent condition today. Glidden Co.

Check No. **9** *on Reply Card*

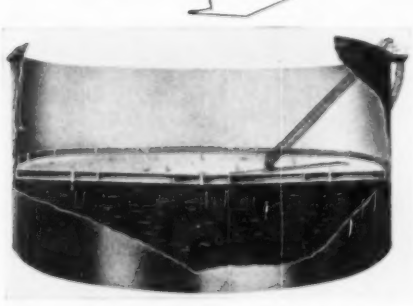
Built-in Coke Crusher Permits Pumping Residua, Flash Bottoms, Black Oils



Severe services such as pumping residuum, flash tower bottoms, and black oil recycle can be handled successfully by the new Type CK "Koke-Krusher", a non-clogging centrifugal pump. Field-proven in a number of refineries according to the manufacturer, the pump has been designed for oils which carry in suspension pieces of hard coke of irregular size and shape. A simple and durable crushing mechanism is located in the suction chamber immediately in front of the impeller eye. Thus, all solids entrained with the pumpage are instantly broken into small dimension powders and will not lodge in the main body or in the impeller passages. The device appears to be essentially a small hammer mill, with the cutters pinioned to the pump shaft in multiple, spiral rows. Bingham Pump Co.

Check No. **10** *on Reply Card*

GRAVER **FLOATING ROOF TANKS**



Cut-away view showing details of Graver Double Deck construction.

• The Full Double Deck construction of the Graver Floating Roof effectively provides "profit protection" in both the production and finished product stages. It is especially recommended for its resistance to the corrosive action of "sour crude"...or for the storage of finished petroleum products in areas too isolated for practical manifolding...and where excessive differences in filling or withdrawal exist, as in a deep water terminal.

Fabricating the finest in *each* type of tank, Graver is in a position to determine which will best fit your particular situation and deliver maximum protection against vapor losses and corrosion. Take a look at the record of Graver Conservation Equipment...talk it over with Graver engineers. Prompt information and recommendations will answer your call, letter or wire.

GRAVER

FABRICATED PLATE DIVISION

GRAVER TANK & MFG. CO., INC.

EAST CHICAGO, INDIANA

NEW YORK • PHILADELPHIA • CHICAGO • CATASAUQUA, PA. • HOUSTON • SAND SPRINGS, OKLA.

AMMONIA

(REFRIGERATION GRADE)

DIRECT SERVICE FROM PRODUCING POINT TO USER IN

TANK CARS

and

CYLINDERS

Discuss contract shipments or spot orders with

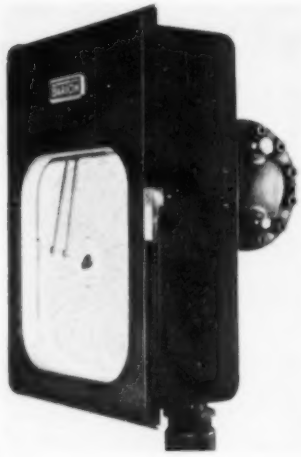
SPENCER

SPENCER CHEMICAL COMPANY

Executive & Sales Offices Dwight Bldg., Kansas City 6, Mo.

What's New!

Internal Pulsation Dampener Provides Full Protection for Aneroid Flowmeter



The Barton Model 202 Recorder, a rupture-proof, bellows type, flow meter, now is equipped with an internal, adjustable, pulsation dampener; providing for the first time, the manufacturer states, a meter of this design with all the advantages of mercury-filled meters but without their inherent service problems. Two serious drawbacks plagued earlier aneroid type meters; the bellows could be easily distorted or ruptured by excessive differential pressure; the sensitivity of the mechanism made it unsuitable for measuring pulsating or rapidly varying flows. Following the successful development a few years ago of the rupture-proof bellows, the company now has developed an efficient dampener. This device controls the rate of flow of the hydraulic fluid in the bellows mechanism from one bellows chamber to the other. The adjustment may be made while the meter is in service. Because the hydraulic fluid is permanently sealed in the bellows mechanism, the dampener assembly can never plug or lose its effectiveness. In addition, because only one source of restriction is introduced into the circuit, none of the hazards are present that result from the use of two external dampeners in the lead lines. The Model 202 is available in pressure ratings from 250 to 3000 psi. Differential pressure ranges extend from 20 to 300 in. water column. Barton Instrument Corp.

Check No. **11** *on Reply Card*

Building

- **FOR THE PETROLEUM INDUSTRY**
- We are fully staffed to design, build, and equip complete refineries and chemical processing plants.
- Under one contract and one responsibility, we deliver each job complete . . . ready for operation.
- We also furnish engineering reports and surveys. Current cost data available at all offices.

The H.K. Ferguson Co.

INDUSTRIAL ENGINEERS AND BUILDERS

THE FERGUSON BUILDING • CLEVELAND, OHIO

OFFICES IN NEW YORK, HOUSTON, CHICAGO, CINCINNATI AND LOS ANGELES

industrial

OIL AND GAS BURNING EQUIPMENT

- Mechanical Atomizing Oil Burners
- Steam Atomizing Oil Burners
- Refractory Burner and Muffle Blocks
- Industrial Gas Burners
- Low Air Pressure Oil Burners
- Fuel Oil Pump Sets
- Valves, Strainers, Furnace Windows
- Tandem Block Combustion Units
- Combination Gas and Oil Burners

Detailed information gladly sent you upon request.

NATIONAL AIROIL BURNER

NATIONAL AIROIL BURNER COMPANY INC.

1297 East Sedgley Avenue, Philadelphia 34, Pa.
Southwestern Division: 2312 South Boulevard Houston 6, Texas

What's New!

Protective Clothing Material Resistant To Most Petroleum Hydrocarbons

"StaSafe Gra-lite" is a new flexible, lightweight fabric provided in the form of protective personal clothing for laboratory and process workers handling hazardous chemicals. The standard material provides high resistance to most hydrocarbons, alcohols, amines, and many esters and halogenated hydrocarbons. It is said to be efficient against the majority of acids, alkalies, and salts. Gra-lite garments include coveralls, bib overalls, coats, open-back jackets, aprons, sleeves, and spats. Standard Safety Equipment Co.

Check No. 12 *on Reply Card*

Ceramic Valve Operates at 300 psi. And 2000° F. with most Corrosives

The "Merit" valve, designed for highly corrosive conditions and extreme temperatures, incorporates a body made of a newly developed ceramic and is suitable for continuous 300 psi. operation at temperatures up to 2000° F. to control the flow of most corrosive gases and liquids with the exception of hydrofluoric acid and hot alkali concentrate. The body is said to be 3 to 4 times stronger than other ceramics, having a tensile strength of 27,000 psi., compression strength of 290,000 psi., modulus of elasticity of 40,200,000. Valve stem is fabricated from the same ceramic, and alternate hard and soft Teflon packing rings are incorporated as seals. Valves are available in ½, ¾, 1, 1½,

NEW . . . STAINLESS STEEL
PRESSURE SAMPLE CONTAINERS

Available in two standard service pressure ranges:
400 psi and 1800 psi. ICC approved. For either single or double valving.

Made of 18-8 Stainless Steel. Other ferrous or non-ferrous cylinders on special order.

OTHER HOKE PRODUCTS

TOGGLE VALVES — PRESSURE REGULATORS — FLOW METERS
CHECK VALVES — NEEDLE VALVES — TORCHES

HOKE INCORPORATED, ENGLEWOOD, NEW JERSEY

WHERE CAN YOU USE IT?

ROCKWELL "KWIKLEEN"
HEAVY DUTY VALVE

for Thick or Heavy Chemical or Petroleum Slurry Lines, Granular Solids, Paper Pulp, Dust, Scale, and Gases Containing Solid Particles

Provides full flow area and quick, tight shut-off. Valve can be cleaned without disconnecting from line by removing cover plate at bottom of sediment chamber; it can be thoroughly flushed with high pressure air, steam or water by connection to plug hole in bonnet.

Made of any metal in pipe sizes from 4" to 24", with lever handle, rising stem hand wheel, chain wheel, air cylinder or other manual or automatic controls. For pressures to 100 p.s.i.

Write for catalog on this and other Rockwell valves.

ROCKWELL VALVES FOR AIR · GAS · LIQUIDS · SOLIDS

W. S. ROCKWELL COMPANY, 250 Eliot St., Fairfield, Conn.

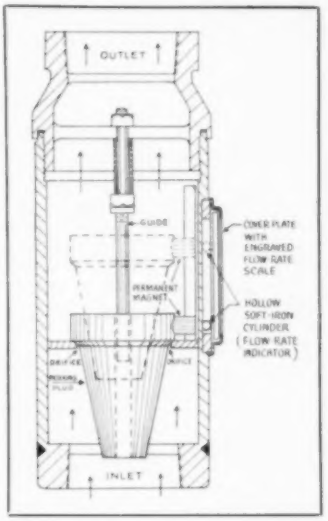
[*To obtain more data on advertised products see page* 192]

2 and 3-in. at present; designed for attachment to 300 psi., standard ASA flanged fittings by stainless steel cap screws. Emmett Machine & Mfg. Inc.

Check No. 13 *on Reply Card*

No Special Installations Are Required With Redesigned Magnetic Flow Meter

The redesigned "Magna-Sight" Flow Gauge can be used to indicate flow rates of: cooling water to furnace doors, bearings; slurries to centrifugal separators; brine and condenser water in cooling systems; fluids in ion-exchange units; and many other applications. The unit consists of a short body, with flanged or screwed pipe connections for placing directly in the line, which accommodates a fixed orifice in the lower end. A tapered metering plug rises and falls with the fluid rate following variable-area metering principles. The metering plug carries a permanent magnet. A hollow, cylindrical, soft-iron follower rides in an external slot. Covering the slot is



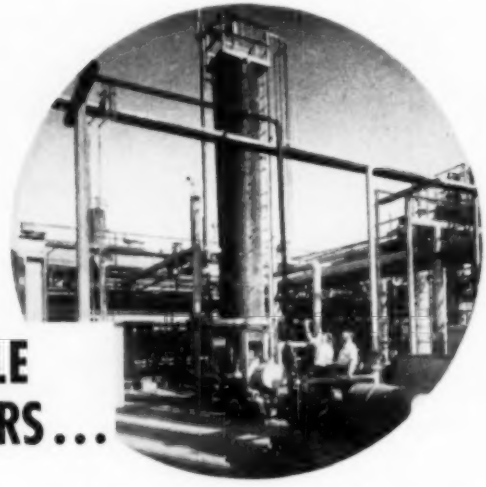
a plate with a scale calibrated in gpm. or mm. The gage is available in brass, bronze, iron, steel, and type 316 stainless; sizes from ¾ to 4 in., and maximum capacities from 3.5 to 250 gpm. It can be used for clear and opaque liquids, slurries, and other fluids. Accuracy averages about 5% over the scale range. Temperatures up to 400° F. and pressures to 500 psig. can be accommodated. No installation precautions are necessary; float position is not affected by turbulence. Fischer & Porter Co. (See also "Whats New!" Item No. 4, p. 585, May, 1949)

Check No. 14 *on Reply Card*

Free Inspection and Test Offered With Line of Bronze Gate Valves

A new line of "OIC" union bonnet bronze gate valves carries a rated working pressure of 200 psi. steam at 550° F.—400 psi. water, oil, and gas non-shock. They are of the screwed end type and are available in solid wedge rising stem, double-disc rising stem, or solid wedge non-rising stem design, all having tapered seats and wedges. Manufacturer is making unusual introductory offer; to users who wish to check the new valve, they will send a valve in size of the user's choice for free inspection and test. If at the end of 30 days, user is not convinced of superiority over any comparable valve, he can return the sample, and the memo billing will be cancelled and transportation paid both ways by the manufacturer. Ohio Injector Co.

Check No. 15 *on Reply Card*



BUBBLE TOWERS...

. . . can now be chemically cleaned "in-place"

FREE BOOKLET!
This 28-page illustrated booklet contains a wealth of tested techniques for cutting corners on many maintenance cleaning jobs. Send for FREE copy! No obligation.

NOW . . . heavy accumulations of waxes, resinous products, entrained crudes, iron sulfides, chlorides and oxides can be completely removed from towers without resorting to costly manual cleaning or dismantling of caps or trays. Now . . . this work can be done faster . . . *much faster* by your *own* maintenance staff through the application, by circulation, of hard-hitting Oakite chemical cleaning compound solution!

At your service is the personal help of your local Oakite Technical Representative. He will gladly give you details . . . help you install this simple Oakite procedure. For immediate action write Oakite Products, Inc., 50D Thames St., New York 6, N. Y.

Technical Service Representatives in Principal Cities of U. S. & Canada

OAKITE

PETROLEUM SERVICE DIVISION

Concentric Dial Indicator Features Easy Reading, Simple Accessibility

The Taylor Concentric or Full-Circle Dial Indicator, for transmitting, receiving, and controlling instruments has a large pointer with a 270° sweep, which stands out effectively with the white numerals on black background so it can be read at distances from 50 to 100 ft. A unique dial construction makes the instrument mechanism easily accessible for inspection or adjustment, by a simple rotation of the dial. The instrument may be used with low pressure unit or mecury manometer actuation for differential or absolute pressure applications. It is available as: 1) simple indicator, 2) indicating receiver, 3) indicating controller, 4) indicating transmitter, 5) indicating transmitter controller, or 6) indicating receiving controller. Standard ranges are 0 to 10 on square root scale and 0-100 and 0-200 on uniform scales. Taylor Instrument Cos.

Check No. **16** *on Reply Card*

Trade Literature

Cities Service East Chicago Plant

Kellogram, Issue No. 1, 1950 *Series;* devoted entirely to an illustrated description of the $20,000,000 modernization of the Cities Service refinery at East Chicago; including Fluid catalytic cracking unit, delayed coking unit, light ends fractionation, boiler house revamp, and oil treating expansion. M. W. Kellogg Co.

Check No. **17** *on Reply Card*

Uses for Chromium Chemicals

Diamond Chromium Chemicals, General Use and Applications; a 32-page handbook presents data on sodium bichromate, its manufacture, and principal uses, including corrosion-inhibition in water-cooled equipment, corrosion prevention in gas condensate wells, etc. Diamond Alkali Co.

Check No. **18** *on Reply Card*

Pressure Vessel Construction

Multi-Layer Manufacture and Assembly, Bulletin No. V-52; an 8-page booklet, the first of a series of six bulletins dealing with the manufacture, design, and use of pressure vessels built up from successive, concentric layers of thin steel plate, wrapped, tightened, and welded together around an inner pressure-tight cylinder. A. O. Smith Corp.

Check No. **19** *on Reply Card*

Gas Compressors and Turbines

Centrifugal and Axial Flow Compressors; a 32-page collection of four technical papers, with charts and tables: "High Pressure Centrifugal Compressor Applications," "Commercial Applications of Centrifugal Compressors and the Complementary

"BTU," alias "International Fuel Thief," wanted in 48 states and Canada for stealing millions of fuel dollars!

He's dangerous! On the loose, he's a constant drain on your capital—steals profits with abandon—ruins equipment—creates miserable working conditions—spreads employee discontent.

He's powerless to pilfer fuel when you protect your equipment with CAREY Industrial Insulation. Actually you *pay* for this protection, whether you have it or not—through fuel waste, heat loss, high production costs, disgruntled employees.

Outlaw this fuel thief—insist on efficient, fuel-saving CAREY Industrial Insulation. You'll find a CAREY representative as near as your telephone.

Write for your free copy of "Heat Insulation For Industry," Dept. PP2, The Philip Carey Mfg. Co., Cincinnati 15, Ohio. In Canada: 1557 MacKay Street, Montreal 25, P. Q.

CAREY Makes the Complete Line!

85% Magnesia—Industrial Rock Wool—Asbestos—Pipe Coverings—Sheets—Blocks—Batts—Papers—Weatherproofings

THE HOUSE OF Carey

[*To obtain more data on advertised products see page* 192]

NEW!

C-O-TWO

DRY CHEMICAL TYPE
FIRE EXTINGUISHER

EXCLUSIVE DESIGN

assures you of fast, positive fire protection

SELF-CONTAINED UNIT . . . rugged construction . . . no extra gadgets protruding or complicated operating parts . . . one of the most efficient, foolproof, easy-to-use fire extinguishers known . . . two convenient sizes, 20 pound capacity and 30 pound capacity.

C-O-TWO DRY CHEMICAL STAYS FREE FLOWING . . . no syphon tubes or valves within the cylinder to become clogged or inoperative . . . discharge hose and squeeze type discharge nozzle remain empty until the fire extinguisher is actuated. Inverting the fire extinguisher before using provides mechanical breakage by changing the position of the dry chemical in the cylinder. Bumping to actuate the fire extinguisher provides additional mechanical breakage as well as continuous carbon dioxide gas pressured agitation or fluffing of the dry chemical. These combined features plus a skillfully blended free flowing extinguishing agent assure you of a faster, more effective and complete discharge.

APPROVED . . . Underwriters' Laboratories, Inc. rating is B-1, C-1. C-O-TWO Dry Chemical is non-conducting, non-corrosive, non-abrasive, non-freezing and non-toxic . . . highly effective on flammable liquid and electrical fires.

RECHARGEABLE ON-THE-SCENE . . . no special tools needed . . . one piece removable top assembly leaves large unobstructed opening in the top of cylinder for refilling. C-O-TWO Dry Chemical for recharging is available in handy pre-measured moisture proof containers.

Write today for complete free information on this new, quick-acting fire extinguisher . . . no obligation.

C-O-TWO FIRE EQUIPMENT COMPANY
NEWARK 1 • NEW JERSEY
Sales and Service in the Principal Cities of United States and Canada
AFFILIATED WITH PYRENE MANUFACTURING COMPANY

What's New!

Axial," "Centrifugal Compressors for Pipeline Duty," and "The Gas Turbine Particularly as Applied to the High Pressure Centrifugal Pipeline Booster." Clark Bros. Co., Inc.

Check No. 20 on Reply Card

Formaldehyde Technical Data

Celanese Formaldehyde Technical Data; a 30-page brochure offering complete information on specifications, physical properties, uses, methods of analysis, storage and handling, and unloading of formaldehyde. Celanese Corp. of America.

Check No. 21 on Reply Card

Pipe Cutting and Threading

Beaver Pipe Tools, Catalog No. 50; 36 pages of catalog data, dimensions, drawings, net and shipping wts. on a line of pipe and bolt cutting and threading equipment, both hand and power operated. Beaver Pipe Tools.

Check No. 22 on Reply Card

Operation of Ring Balance Meters

Hagan Bulletin M-51, four pages covering the general subject: "Here's How Hagan Ring Balance Meters Provide Automatic Compensation for Pressure, for Temperature, for Pressure and Temperature." Hagan Corp.

Check No. 23 on Reply Card

Welding Fittings

Midwest Piping Products; Catalog No. 48; a 65-page complete catalog containing charts, tables, graphs, specifications, welding data, design formulas, metallurgical and other engineering data useful for buyers of pipe, welding fittings, pre-fabricated piping, pipe coils, forged flanges, and other specialties. Midwest Piping & Supply Co., Inc.

Check No. 24 on Reply Card

Petroleum Processing Index

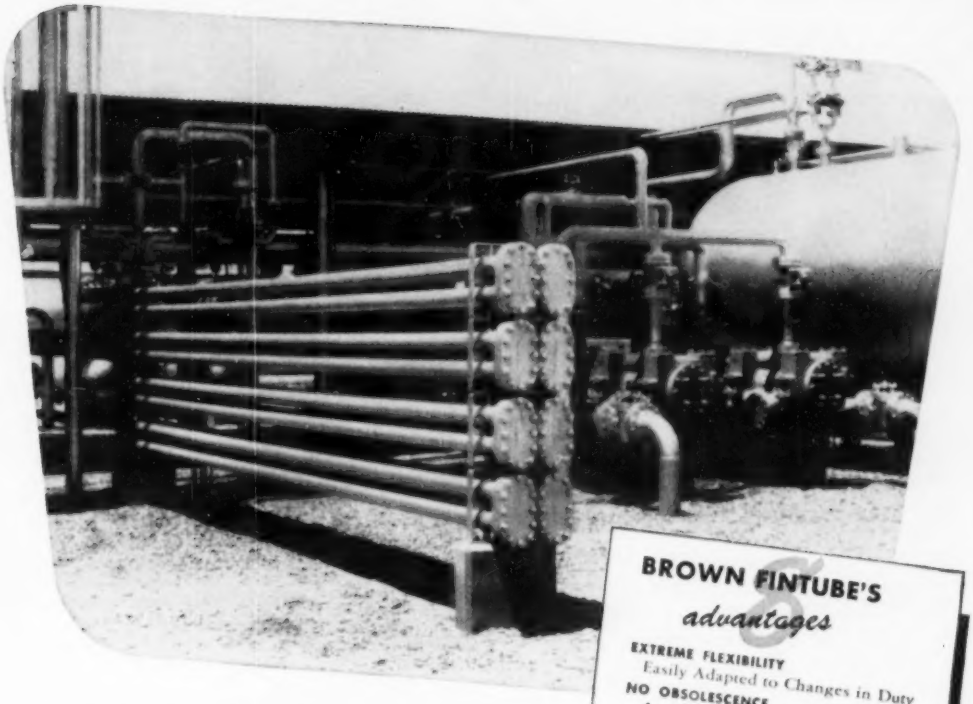
PETROLEUM PROCESSING Index for 1949: includes subject and author index for all feature articles and regular departments for the 12 issues of this magazine published during 1949; available now. National Petroleum Publishing Co.

Check No. 25 on Reply Card

Leak Detector

Consolidated Leak Detector, Model 24-101A; 16 pages telling how this mass spectrometer type instrument is used, covering both the probe and the envelope methods. Accessories, spare parts, and specifications are listed, along with service information. Consolidated Engrg. Corp.

Check No. 26 on Reply Card



BROWN FINTUBE'S *advantages*

EXTREME FLEXIBILITY
Easily Adapted to Changes in Duty
NO OBSOLESCENCE
Avoiding Waste and Expense
FLANGED HEAD END ASSEMBLY
Eliminating Ground Joint Seals
EASY MAINTENANCE
Using Only Common Tools
CONTINUOUS OPERATION
No Shut-Downs For Cleaning
REDUCED STORES REQUIREMENT
Minimizing Investment and Handling
QUICK DELIVERY
Only a Few Hours in Emergency
INCREASED CORROSION ALLOWANCE
Longer Tube Life

easy maintenance

Brown Fintube Design Simplifies Inspection and Maintenance

● Brown Fintube Sectional Hairpin Heat Exchangers reduce maintenance three ways:—

1st. BY MINIMIZING COKING. The much increased surface area permits efficient operation at low "skin" temperatures, minimizing coking and building up on the tubes.

2nd. AVOIDING BACK EDDIES. The controlled flow through the longitudinal passages keeps all the material in continuous motion, avoiding baffles, back eddies, and stagnant areas that cause fouling.

3rd. EASY TUBE REPLACEMENT. A fintube hairpin can be taken out of the shell, and a clean hairpin substituted, by only 2 men, in less than 10 minutes, using only ordinary tools and *no special rigging.*

For the utmost in efficiency and economy, use Brown's proven, welded fintube heat exchangers throughout your plant. Estimates and quotations furnished promptly. *Write for Bulletin No. 481.*

THE BROWN FINTUBE CO.
ELYRIA, OHIO

SECTIONAL HAIRPIN HEAT EXCHANGERS

Having SLIDE RULE trouble?

When the problem is moving air or gas, turn to *R-C dual-ability* for accurate, dependable answers

That's one job we know, inside-out. For almost a century, we've been air-and-gas specialists, exclusively. Without being immodest, we think our engineers are the best informed in the industry, on blowers, exhausters, gas pumps and related equipment.

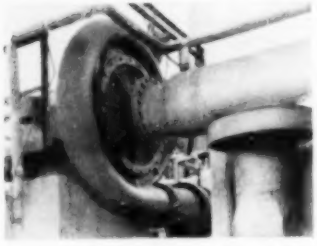
They have an extensive line to draw on, too. They make unbiased recommendations between Centrifugals and Rotary Positives—we're the only company offering this *dual choice*. With capacities ranging from 5 cfm to 100,000 cfm, we can supply standard units closely matched to the job, for efficiency and economy.

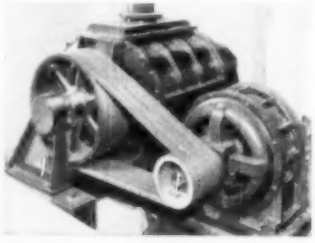
As to how R-C equipment performs, our old-time, repeat customers are the best answer to that. They'll testify that you will reduce your buying and operating problems when you call on R-C air-and-gas specialists.

ROOTS-CONNERSVILLE BLOWER CORPORATION
502 Texas Avenue, Connersville, Indiana

CENTRIFUGAL

Type OI, Single-stage Centrifugal Blower for outdoor operation at oil refinery. Capacity 11,750 cfm.





ROTARY

R-C Rotary Positive Blower used in oil processing. Capacity 3,160 cfm.

ROOTS-CONNERSVILLE

BLOWER BUILDERS SINCE 1854

ONE OF THE DRESSER INDUSTRIES

What's New!

Centrifugal Boiler Feed Pumps

Pacific Centrifugal Pumps for Boiler Feed Service, Bulletin 109: 16 pages covering models in capacity range to 2700 gpm., in carbon and chrome alloy steels; their design and construction, illustrated with sectional views in color; and helpful engineering data. Pacific Pumps, Inc.

Check No. **27** *on Reply Card*

Oil and Water Coolers

Conseco Coolers, Type "AI": 24 pages of catalog information, dimensions, specifications, etc. on heat transfer equipment for lube oil cooling, including engineering data. Condenser Service & Engrg. Co., Inc.

Check No. **28** *on Reply Card*

Materials Handling Accessories

Attachments, Tools & Accessories for Hyster Lift Trucks, Karry Krane, and Straddle Trucks, Bulletin 1129: 28-page catalog covering such new material-handling equipment as drum handlers which need no pallets, rams, scoops, side-shift carriages, revolving arms, etc. The Hyster Co.

Check No. **29** *on Reply Card*

Laboratory Chemicals

Machlett Laboratory Chemicals and Reagents; 80-page catalog covering complete line in all usual grades of quality; including prices. E. Machlett & Son.

Check No. **30** *on Reply Card*

Leak Detector

Veeco Mass Spectrometer Leak Detector, Bulletin LD-6; a four-page folder describing the operation and recommended applications for the Model MS-2, useful for vacuum, fixed pressure, or special atmosphere for testing distillation equipment, valves, welded tanks and vessels, heat exchangers, and many others. Vacuum Electronic Engrg. Co.

Check No. **31** *on Reply Card*

For Your Convenience

Business reply cards are included in this issue of PETROLEUM PROCESSING to assist you in obtaining more information on any items reviewed in "What's New!" You'll find them facing page 193. Just check the numbers corresponding to the numbers on the items you're interested in, fill in the bottom of the card, and drop it in the mail. No postage required.

Personals

Thomas B. Kimball has been appointed assistant manager of refineries for Sinclair Refining Co., effective Jan. 1. He previously held the position of technical assistant to the vice president of manufacturing.

Mr. Kimball

Mr. Kimball, who has been associated with the petroleum industry for nearly 27 years, was graduated from the University of California in 1923 with a B. S. degree in chemical engineering. Upon graduation he was employed by Shell Oil Co., and later joined the Sinclair organization in the research and development department at East Chicago, Ind. At East Chicago he was in charge of the cracking division, and of the process engineering and developement of light-oil processes.

In 1943 he was transferred to Sinclair's New York offices as technical assistant to the vice president of manufacturing, and during the past several years has developed numerous patents on light oil treating, and on both thermal and catalytic cracking.

During World War II, Mr. Kimball was active in the manufacture of aviation gasoline, particularly by catalytic cracking, and served on several wartime committees. He is a member of the American Institute of Chemical Engineers.

* * *

Edward M. Dons has been named general superintendent of manufacturing operations for the West Tulsa refinery of Mid-Continent Petroleum Corp.

Mr. Dons joined Mid-Continent in 1922 as a draftsman in the manufacturing department. From 1928 to 1934 he was engaged in experimental engineering and the development of new processes and equipment. In 1935 he was named head of the design engineering department, and in 1941 was promoted to chief engineer.

Another promotion, in March, 1943, upped him to assistant general superintendent in charge of all engineering, construction and mechanical operations, a position he has held until now.

* * *

V. E. Sicks has been appointed chief engineer for the basic refinery of Cities Service Refining Corp. at Lake Charles, La. He was formerly superintendent of the government-owned butadiene plant which Cities Service operates at Lake Charles.

Gordon B. Wooster, formerly assistant superintendent in the butadiene plant, has been appointed superintendent to succeed Mr. Sicks.

* * *

Twenty-nine years without a lost-time accident in the shop of which he was general foreman is the record rung up by **A. J. Olson,** Standard Oil Co. (Indiana), who retired recently. Foreman of the company's Whiting, Ind., refinery tin shop since 1916, Mr. Olson has been honored by plant officials and by National Safety Council, which presented him with its "Award of Merit." He is the first man not exclusively in safety work to receive the council's award.

Mr. Olson was born in Sweden in 1884. He received his early schooling and metal work apprenticeship in Jamestown, N. Y., joining Standard in 1913. He attributes his success in safety to direct contact with each man before going on a job.

* * *

New officers of the Society of Automotive Engineers for 1950 include **Albert H. Fox,** Standard Oil Co. (Ind.), vice president of Diesel Engine Activity; **Arthur O. Willey,** Lubrizol Corp., vice president of Fuels and Lubricants Activity; and **Matt E. Nuttila,** Cities Service Oil Co. (Pa.), vice president, Transportation and Maintenance Activity.

Mr. Fox

Mr. Willey

Mr. Nuttila

Mr. Fox is in Indiana Standard's research department, where he is a group leader in charge of work on Diesel fuel applications. He was graduated from Purdue University in 1928 with the degree of bachelor of science in mechanical engineering. He was employed by The Texas Co. (China) Ltd., as an engineer from 1928 to 1936, and travelled extensively in the industrial centers of northern China. He was located in the Mukden office at the time the Japanese took over Manchuria, and was later moved to China proper. Mr. Fox obtained his master's degree from Purdue in 1937 and joined Indiana Standard's research department the same year.

Mr. Willey is vice president in charge of engineering at Lubrizol. He is a graduate of the University of Maine, and after receiving his master's degree there he came to Cleveland, where for several years he was professor of Mechanical Engineering at Case School of Applied Science. He first became connected with Lubrizol as a consultant, and later was made director of engineering. He assumed his present position as vice president in charge of engineering in 1946.

Mr. Nuttila is superintendent of motor vehicles for Cities Service Oil Co. (Pa.). He received a B.S. degree from Michigan State College, and since joining Cities Service has successively risen from his original position as a mechanic's helper to the post of assistant to the manager of the automotive department in 1925. He assumed his present position in 1931. In 1942 he went to Puerto Rico for the Office of Defense Transportation as a member of a five-man committee to investigate and recommend a solution for the island's serious transportation problems, an assignment for which he received a Presidential Citation.

* * *

Assignments for 20 members of the supervisory group at the Baton Rouge, La., refinery of Esso Standard Oil Co., Louisiana Division, have been announced by **H. J. Voorhies,** general manager of the refinery. The changes are in line with a program established four years ago to broaden the experience and capabilities of the division and department heads, and to improve the management of the refinery's diversified operations.

The new assignments are:

C. G. Morrison, from assistant head of the maintenance and construction department, in charge of field coordination, to assistant process superintendent.

Fred Kring, Jr., from assistant process superintendent to superintendent of refining and oil movement.

Dr. D. F. Edwards, superintendent of refining and oil movement, to superintendent of the paraffine and lubricating department.

W. G. McAndrew, superintendent of paraffine and lubricating, to superintendent of package and shipping and oil conservation.

W. C. Clark, superintendent of

package and shipping and oil conservation, to assistant manager of employe relations.

Dr. J. P. Cogan, head of process engineering, to assistant head of the technical division.

Dr. F. A. L. Holloway, assistant head of the technical division, to head of petroleum technical service.

D. O. Swan, head of petroleum technical service, to general foreman of catalytic cracking.

J. F. Wright, head of cost analysis, to head of process engineering.

P. G. Slachman, coordinator of contracts, to head of cost analysis.

E. R. Wilkinson, assistant manager of employe relations, to assistant head of maintenance and construction, in charge of crafts.

E. G. Miller, assistant head, maintenance and construction, in charge of crafts, to assistant head of refinery services with direct responsibility for the new main office building.

G. A Stein, Jr., catalytic cracking foreman, to assistant head of maintenance and construction, in charge of field operations.

Dr. J. E. Wood, general foreman, alcohol plants, to coordinator of contracts.

Dr. M. C. Fuqua, group head, chemical products laboratory, to general foreman of alcohol plants.

R. F. Howe, assistant head, chemical products laboratory, to section head, petroleum technical service, in charge of refining and cracking.

Dr. C. T. Steele, section head, petroleum technical service, in charge of refining and cracking, to assistant head of the chemical products laboratory.

C. D. Singer, foreman, light ends and polymer, to section head, petroleum technical service, in charge of paraffine and lubricating oils.

A. C. Matthies, section head, petroleum technical service, in charge of paraffine and lubricating oils, to foreman, light ends and polymer.

M. H. Grosz, cost analysis, to assistant head, yield cost.

* * *

James F. Hartman has been named refinery superintendent of Bay Petroleum Corp.'s McPherson, Kans., plant, replacing **Amos G. Pollard,** who was transferred to Chalmette Petroleum Corp., Chalmette, La., as superintendent.

Mr. Hartman received his degree in petroleum refining from the University of Pittsburgh, and was formerly superintendent of the Frontier Oil Refining Corp., Buffalo, N. Y. Previous to that he was process and development engineer for Sun Oil Co. and National Refining Co.

* * *

California Research Corp. has named **A. L. Snow** vice president and manager of its patent department, succeeding **J. N. Adams,** vice president who retired Dec. 31, 1949, after 31 years of service. Mr. Snow, who joined California Research, subsidiary of Standard Oil Co. of California, in 1935 as a patent attorney, has been assistant manager of the patent department.

Mr. Snow

The company also has appointed **O. S. Loud** and **H. B. Wands, Jr.** as assistant managers in the department.

* * *

Robert L. Grun has been appointed chief fuels and lubricants engineer in the process oil section of Gulf Oil Corp.'s new Industrial Products Engineering Division. Mr. Grun, a chemical engineering graduate of Pennsyl-

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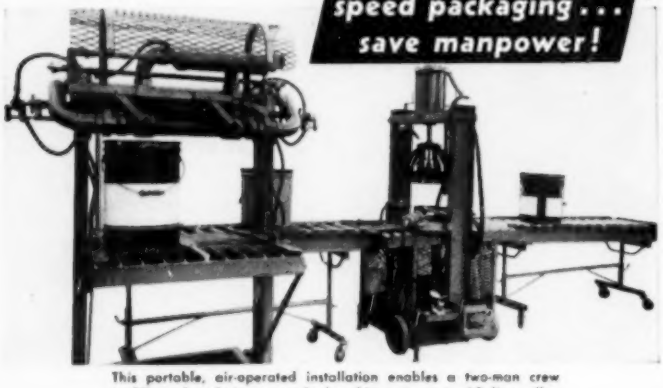

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vania State College, has been associated with Gulf since 1936, when he joined the Refinery Technology Division at Philadelphia as an assistant chemical engineer.

During World War II he served as a Petroleum Specialist with the U. S. Navy at various refineries on the East and Gulf Coasts, and was subsequently released to inactive duty with the rank of Lieutenant Commander. He returned to Gulf as a lubrication engineer in the lubricating sales department, in which capacity he served until his recent appointment.

* * *

Robert E. Donovan, manager of the safety division, Standard Oil Co. of Calif., is the new president of the Veterans of Safety, an international association of professional safety engineers who have devoted at least 15 years to leadership in their field.

* * *

William Klabunde has joined the staff of Houdry Process Corp. in Philadelphia as a patent attorney. A graduate of the New York Law School and a member of the New York Bar, Mr. Klabunde for the past 12 years was associated with an engineering firm in New York City in a similar capacity. He studied engineering at the Stevens Institute of Technology in Hoboken, N. J.

* * *

Sun Oil Co.'s director of industrial relations, **William D. Mason,** has retired, effective Dec. 31, after having served with the company since 1926. He will, however, continue as board member until the April, 1950, stockholders meeting. Mr. Mason is succeeded by **William E. Zimmerman,** formerly assistant manager of the industrial relations department.

* * *

Ed Wrangle of Seminole, Okla., has been appointed superintendent of Cities Service Oil Co.'s new Chico, Tex., gasoline plant, scheduled to go on stream this month.

* * *

Dr. J. W. Bertetti, chief engineer of the El Dorado refinery of Pan-Am Southern Corp., has been promoted to technical director. In his new position, Dr. Bertetti will have supervision of mechanical and chemical engineers, and laboratory chemists and technicians. To assist him in the supervision of the technical department, **Harry K. Wheller** has joined the Pan-Am Southern organization as assistant technical director at El Dorado.

Dr. Bertetti has the degree of B. S. in chemical engineering from the University of Illinois, and the degrees of M.S.E. and Ph.D. in chemical engineering from the University of Michigan. In 1934 he entered the research department of Standard Oil Co. (Ind.) at Whiting, Ind., and was transferred in 1936 to the Texas City, Texas, research laboratory of Pan American Refining Corp., a subsidiary of Indiana Standard. In 1942, at the time that Root Petroleum Co. (now Pan-Am Southern Corp.) was entering the wartime aviation gasoline program, Dr. Bertetti came to El Dorado as assistant chief engineer, and in 1947 was made chief engineer.

Mr. Wheeler received a degree in chemical engineering from the University of Cincinnati in 1943. From 1943 to 1947 he worked in various capacities in the research department of Indiana Standard. Since 1948 he has been in the manufacturing department at the company's Whiting refinery, as assistant general foreman of the pressure stills.

Other changes announced at this time at Pan-Am Southern's El Dorado refinery include the promotion of **R. F. Provine** from the engineering department to assistant area foreman (refinery operations), and **R. R. Gumaer** from technical assistant in the engineering department to the position of technical assistant to the general manager of the refinery.

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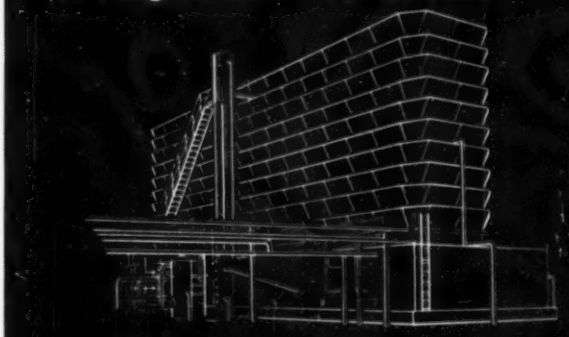

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EDITORIAL VIEWPOINTS...

Opinions and Comments on Current Topics

The Problem of the Growing Child

TWO economic factors arising this past year serve to emphasize the need for making greater utilization in motor fuels of the liquids recovered in the processing of natural gas. One factor is the relatively small increase in the consumption of Liquefied Petroleum Gas in 1949 as compared with previous years. The annual gains in LPG consumption of from 20 to 40% which have been taking place over the past 15 years have provided a substantial market for the increasing output of propane and butanes from the natural gasoline and cycle plants.

There is a natural explanation for the low gain of 8.5% in use of the LPG product in 1949; namely, the mild 1948-49 winter and the increased competition of natural gas with LPG due to the placing in service of new gas transmission lines. LPG consumption in 1949 undoubtedly was at an abnormally low rate of gain and an increase of 12% in consumption is predicted during 1950. However, it is to be questioned if the high rate of increases of past years will continue and take up a large proportion of the growing production of natural gas liquids.

A second significant factor in the problem lies in the fact that, as a result of 1949 industry operations, the supply of natural gas liquids now is a larger proportion of the total supply of hydrocarbon liquids than ever before. Domestic crude oil production dropped around 8% in 1949 from the previous year. However, due to new natural gasoline and cycle plants starting operations, the supply of gas liquids in 1949 was about 7% larger than in 1948. The approximately 155,000,000 barrels of natural gas liquids recovered in 1949 were 7.8% of the total supply of crude oil and gas liquids, while the approximately 145,000,000 barrels of gas liquids recovered in 1948 were only around 6.7% of the total. Regardless of the trend of U. S. crude production, the output of natural gas liquids will trend upward in 1950 and future years. The above comparisons do not include the volume of around 23,000,000 barrels of liquefied refinery gases produced for fuel and chemical purposes in 1949, which also supplied the LPG market.

There is indicated for 1949 a small relative increase in the use of natural gasoline at refineries in motor fuel manufacture. This may have been due to the refiners' desire to stretch the volume of motor fuel manufactured from the smaller volume of crude run to stills this past year. However, it is the utilization in motor fuels of the growing volume of propane and butane fractions realized from natural gas processing which is likely to become a pressing problem for both the petroleum and automotive industries, in the interests of conservation of our natural resources.

"150 Miles Per Gallon is Possible"

WHAT started out 10 years ago as a fuel economy stunt at the Wood River Research Laboratory of Shell Oil Co. has stimulated interest of automotive engineers to the point that a paper on the subject was presented at the recent annual meeting in Detroit of the Society of Automotive Engineers.

The Mileage Marathon is run annually over a 14-mile course, the participants being the oil company's chemists and engineers, who work in their own backyards to modify the family car so as to get the best possible mileage out of it. All types and models of cars are entered, all using the same commercial premium grade of fuel.

The 1947 Studebaker which won the 1949 contest with a record 150 miles to the gallon had a maximum of 28 miles before modifications were made to improve fuel economy. Among several mechanical changes the compression ratio was increased from the standard 6.5 1 to 10 /1. This particular change was responsible for only a modest gain in mileage. Special driving techniques played a considerable part in the results.

The Mileage Marathon contestants are limited to simple car adjustments and mechanical changes. However, their achievements indicate what can be accomplished when the car manufacturers seriously tackle the problem of getting more miles to the gallon from the cars the public drives.

Dr. Hobart Dickinson—Scientist

THE petroleum industry lost a good friend and technologists a source of inspiration, in the death of Dr. Hobart Cutler Dickinson in a Washington hospital recently, shortly after his 74th birthday. He had been with the National Bureau of Standards in various capacities since 1903, except for a short interval, until his retirement in the fall of 1945. As an authority on the subject of automotive fuels, among other fields, his work brought him in contact over many years with the automotive engineers and other technologists with the oil companies.

Dr. Dickinson was outstanding in that he not only had a zealous desire to get at factual information on scientific matters, but he also demanded that the facts be properly evaluated in relation to practical problems. As a member of the Federal Specifications Board, for example, when the proposition came up for amending the sulfur limits on motor gasoline, or making some other change in the light of new knowledge at hand, he counseled waiting until it could be fully determined what the effect of the proposed change might be on motor fuel manufacture or utilization.

He was a strong supporter of the campaign *National Petroleum News* conducted in the early 20's against the so-called gasoline tonics which then began to flood the market, some of them put out by reputable accessory manufacturers. Against considerable opposition he maintained that proof had not been established that the fuel vitalizers improved the gasoline in any respect. Under his supervision tests were run at the Bureau of Standards, and he would have been the first to reverse his position had the scientific facts shown him to be wrong.

Throughout his scientific career Dr. Dickinson maintained what all men respect, unswerving devotion to high ideals.

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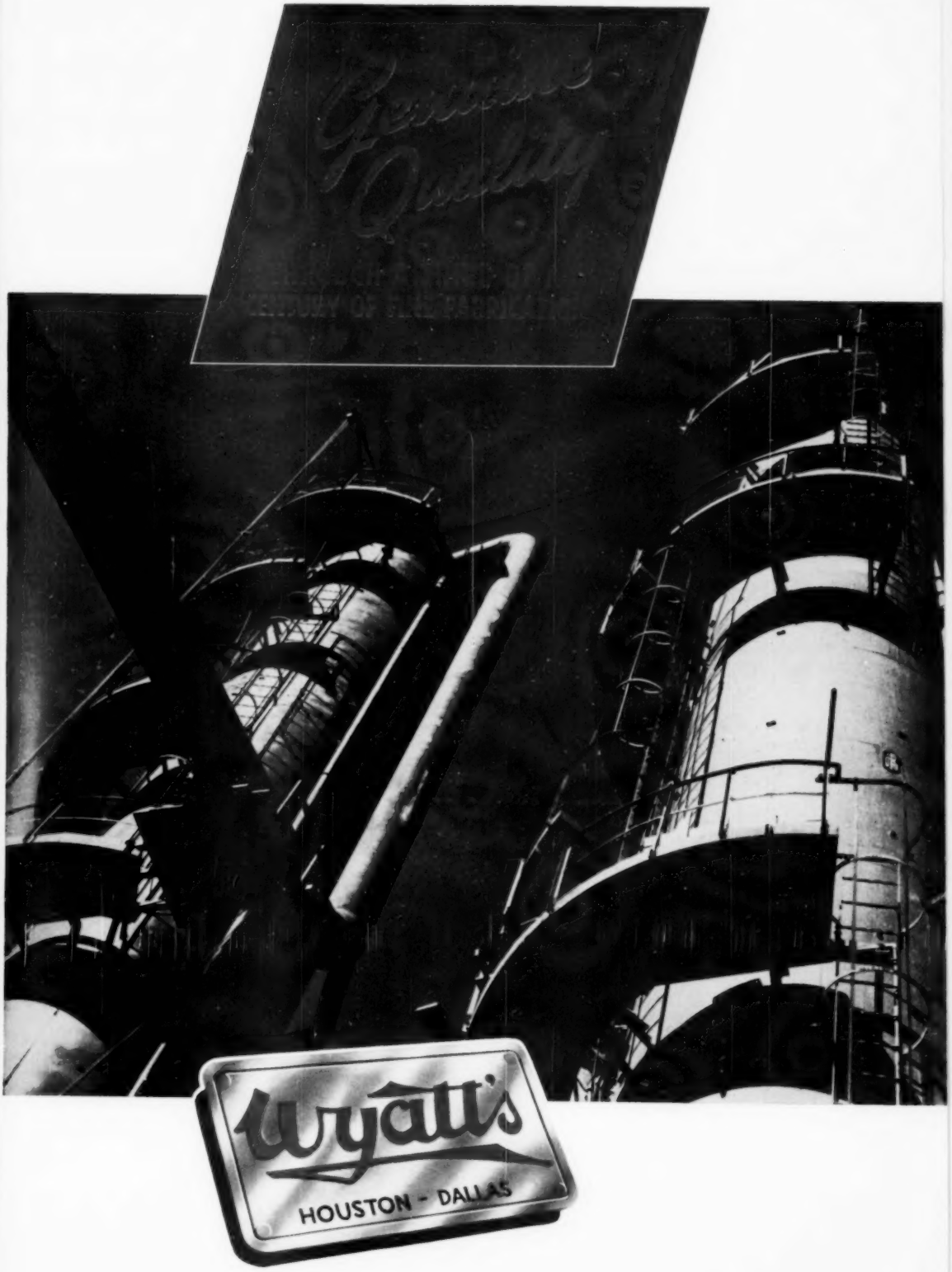
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